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# Colorado River Hydrologic Region

## Colorado River Hydrologic Region Summary and Recommendations

### Summary

Despite the extreme arid climate conditions, reliable water supplies for the Colorado River Hydrologic Region has made it possible to maintain, and even expand, key local industries, agriculture, recreation, and tourism. Yet, despite all of the land use activities, the region's topographic landscape, shaped by tectonic and past volcanic activities, remains as scenic and beautiful as ever. This includes the Salton Sea. Although sustained by agricultural tailwater and treated and untreated urban wastewater flows, its shoreline provides critical habitat for resident and migratory birds. The present reliabilities of its water supplies have not stopped local water agencies from planning and implementing programs and projects to maintain the quality and quantity of those supplies, particularly groundwater, for the future. This includes water use efficiency and groundwater conjunctive use programs and water supply transfers. Activities are also underway to protect and expand the region's important environmental resources; in particular the Salton Sea.

### Resource Management Strategies and Policies

[This subsection contains a discussion of the following topics. (Primary authors may be Regional Office staff, coordinating with design teams and regional forum participants with an emphasis on local integrated regional water management [IRWM] managers.)

- Implementation recommendations (and priorities where possible).]

[Sources for this information may be IRWM plans, the Senate Bill x7-7 process, urban water management plans, agricultural water management plans, groundwater management plans, water elements of general plans, floodplain management plans, stormwater plans, Regional Water Quality Control Board basin plans and water quality reports, watershed management plans, habitat conservation plans, multi-species conservation plans, etc.]

[Considerations for this subsection:

- This section will directly support funding recommendations in the Update 2013 finance plan (within Volume 1).
- Priorities will be regionally driven and can vary from specific regionally preferred projects to entire IRWM or other plans.
- Priorities can be expressed by IRWM, county, or another geopolitical subdivision.]

[Placeholder: Groundwater content being developed including:

- Summary of groundwater-related resource management strategies and policies in the Hydrologic Region.
- Summary of groundwater data gaps for the Hydrologic Region, how these gaps affect groundwater management and policy, and recommendations to reduce data gaps in the future.
- Selected maps and tables from the main text of the report, as appropriate.
- Discussion on groundwater sustainability and sustainability indicators to monitor progress towards the resource sustainability.]

## Finance

[This subsection contains a discussion of the following topics.

- An estimate of total funding proposals within the region.
- Public benefits of local and regional proposals (eligible for State funding).
- Cost-sharing criteria.]

[Considerations for this subsection:

- This section will directly support funding recommendations in the Update 2013 finance plan.
- Same sources and authors referenced under “Resource Management Strategies and Policies,” above.
- Identify incentives, funding sources, and State actions to support regional strategies.]

## Water Planning and Governance

[This subsection contains a discussion of the following topics.

- Institutional improvements, expansion of IRWM partnerships (e.g., tribal) and alternatives to IRWM where appropriate.]

[Considerations for this subsection:

- This section will take a critical look at IRWM as it pertains to each region.]

[Placeholder: Groundwater content being developed including:

- Summary of groundwater governance associated with the various groundwater management plans (GWMPs), Integrated Regional Water Management (IRWM) Plans, conjunctive management projects and groundwater recharge projects, groundwater monitoring, groundwater ordinances, and adjudicated groundwater basins within the Hydrologic Region.
- Summary table of groundwater-related planning and governance within the Hydrologic Region.
- Summary discussion on Case Studies – successes and challenges.]

## Current State of the Region

Flooding is a significant issue in the Colorado River Hydrologic Region, and exposure to a 500-year flood event would threaten 38 percent of the population, more than \$20 billion dollars of assets (crops, buildings, and public infrastructure), and over 180 sensitive species. Even with this level of exposure, public awareness about flooding is inadequate because most events occur as a result of infrequent, high-intensity, summer storms.

Floods can be caused heavy by rainfall; by dams, levees, or other engineered structures failing; or by extreme wet-weather patterns. Flooding from snowmelt typically occurs in the spring and has a lengthy runoff period. Flooding from rainfall occurs in the winter and early spring, particularly when storms arriving from the Gulf of Alaska draw moisture-laden air from the tropics.

[Note: Align with region description in IRWM standards.]

## Setting

The Colorado River Hydrologic Region (region) is located in southeastern California and contains 12 percent of the state’s land area. The Colorado River provides most of the eastern boundary, and the border

with Mexico forms the southern boundary (Figure CR-1). The region includes Imperial County and portions of Riverside, San Bernardino, and San Diego counties.

### **PLACEHOLDER Figure CR-1 Colorado River Hydrologic Region**

[Any draft tables, figures, and boxes that accompany this text for the advisory committee draft are included at the end of the report.]

Geology and climate shape the topography of the Colorado River region. Numerous faults exist, including the San Andreas fault, and they are responsible for the mountainous terrain in the north and the large valleys and plains in the south. The northern third of the region is part of the Mojave Desert and features small to moderate mountain ranges, dormant volcano cinder cones, hills, and narrow and U-shaped valleys. The San Bernardino and San Jacinto mountains are in the north and have peaks at or above 10,000 feet above sea level. The remainder of the region is part of the Sonoran Desert, is less mountainous, and is dominated by the Salton Sea and the Imperial, Coachella, and Palo Verde valleys. The Salton Sea is the largest lake in California and is sustained mostly by agricultural runoff from the Imperial and Coachella valleys. The Salton Sea provides critical nesting habitat for migratory birds in the Pacific Flyway.

The Coachella and Imperial valleys are to the north and south of the Salton Sea, respectively. The Palo Verde Valley is on the western bank of the Colorado River. The surface of the Salton Sea and some of the land in the Coachella and Imperial valleys are as much as 230 feet below sea level. Most of the agricultural and urban land uses for the region are in these valleys. The Imperial Valley contains most of the agricultural area uses, and the Coachella Valley has most of the urban areas. Native vegetation in the creosote bush scrub classification is able to survive the hot summers and sparse rainfall common to the valleys and plains. In the mountains, the cooler and wetter climate supports vegetation in the pinyon-juniper woodland class. Major rivers in the region are the Colorado, Alamo, New, and Whitewater. Most other rivers, streams, and washes, such as the Piute Wash and San Felipe Creek, are intermittent or dry. Playas, or dry lakebeds, are common in the eastern portions of the region. Major water conveyance facilities are the All-American and Coachella canals.

The Colorado River region has two of the state's largest public parks. The 600,000 acre Anza-Borrego Desert State Park is west of the Salton Sea in the Santa Rosa, Borrego, and Vallecitos mountains. Joshua Tree National Park is in the Little San Bernardino Mountains.

### **Watersheds**

Watersheds exist throughout the Colorado River Hydrologic Region. Many of the prominent watersheds offer different combinations of native and man-made environmental, urban, and agricultural land and water uses. Included are the Salton Sea Transboundary watershed, located in both the Coachella and Imperial Planning Areas (PA), the Imperial Reservoir and Lower Colorado River watersheds in the Colorado River PA, and the watersheds for San Felipe, Fish, Vallecito, and Carrizo Creeks in the Borrego PA. Other key watersheds, largely devoid of urban and agricultural uses include the Havasu-Mojave Lakes and Piute in the Colorado River PA and the Southern Mojave in the Twenty-nine Palms-Lanfair PA.

### *Salton Sea Transboundary Watershed*

The Salton Sea Transboundary watershed stretches over two counties, Imperial and Riverside, encompasses about one-third of the land area of the hydrologic region. It also includes most of the Coachella and Imperial Valley PAs. Key hydrologic features are the Salton Sea, the Whitewater River in the north, the Alamo and New rivers in the south, and San Felipe Creek in the west. The watershed has been designated as a Category 1 (impaired) watershed using the criteria in the 1997 California Unified Watershed Assessment.

The most prominent of the features is the Salton Sea, a saline lake located in a geologic depression identified as the Salton Trough. With no outlet to the Pacific Ocean or Gulf of California, drainage in the depression is internal, all surface water flows to the Sea. The Sea was created over 100 years ago by failure of a temporary levee along the Colorado River. Although its physical characteristics have fluctuated over the years, the Sea has remained relatively constant over the past two decades. Total volume of water in the Sea is estimated at 7.5 MAF, it has a surface area of about 376 square miles, and it has 105 miles of shoreline. Average depth is slightly less than 30 feet, with its deepest spot determined to be 51 feet. Elevation of the water surface is 227 feet below sea level. Its size, shape, and volume has been sustained by annual inflow of 1.3 MAF of agricultural tail and drain water, surface runoff, treated and untreated urban wastewater flows from the Coachella, Imperial, and Mexicali valleys and a small amount of subsurface flow. Because of the extremely arid climate, evaporation of water from the Sea is about equivalent to the quantities of inflow water, 1.3 MAF.

With the nutrients contained in the inflow, the Sea and its native and man-made wetlands provide critical habitat for migratory birds in the Pacific Flyway. Eared Grebes, White-faced Ibis, American White Pelicans, Yuma Clapper Rail, Black Skimmers, Double-breasted Cormorants, and Gull-billed Terns are just a few of the species of birds which can be found during winter nesting, often in the hundreds and thousands, in the calm and serene environment around the Sea. The fishery in the Sea is also important as a food source for the birds and for recreational enthusiasts.

To the north is the Coachella Valley which has a blend of urban and agriculture, with a greater emphasis on the former. To the south is the Imperial Valley which features major agricultural land uses and operations. Over 400,000 acres of land are cultivated in the Imperial Valley annually. Two aqueducts are in operation, the All-American and Coachella canals which transport Colorado River water supplies to both areas. Groundwater supplies are also important, especially in the Coachella Valley PA. Major cities include Indio, Palm Springs, Cathedral City, and Palm Desert in the Coachella Valley, El Centro, Brawley, and Calexico in the Imperial Valley.

Salinity levels of the Sea are critical issues. The inflows from the different sources identified above are contributing as much as 4.5 million tons of salts each year. The current level of salts is 44 parts per thousand; the Pacific Ocean's level is 35 ppt. Reductions in the annual inflow quantities due to the implementation of the Federal Quantification Settlement Agreement, without replacements, will probably result in salinity level increases. The local fish and invertebrate species will be impacted with the higher level which, in turn, would have negative impacts on the population of the migratory and shoreline birds.

The water quality issues posed by the New and Alamo Rivers have been documented in the last California Water Plan. The New River transports treated and untreated urban wastewater and untreated agricultural tail water from the Mexicali Valley, treated urban wastewater, and treated industrial, and agricultural tail

and drain water from the Imperial Valley to the Sea. The Alamo River carries some treated urban wastewater, but, as do the drainage systems in Imperial and Coachella Valleys, carries mostly agricultural tail and drain water flows to the Sea. However, a major effort is underway to implement a strategic plan to mitigate the quality issues, establish a monitoring system to track the progress of the cleanup, and expand a TMDL surface runoff control program currently being implemented, on a voluntary basis, by the IID and Imperial Valley farmers. Goals of the runoff control program are to decrease the sedimentation of the New and Alamo Rivers. The New River Wetlands Project, began in 2003, is a collaborative project which includes U. S. Congressman Duncan Hunter (R-Alpine), Desert Wildlife Unlimited, the IID, and the USBR. Goals of the project were to construct aeration ponds and establish two small wetlands on the New River to help with the cleanup of the water downstream from the International Border. These sites have been established. A third area was completed to the northeast of the City of Brawley on the Alamo River. As many as twelve wetland areas could be established in the future, most are for the New River. The construction of the three areas was handled by the USBR and Imperial Irrigation District and was made possible through federal funding. Many other agencies and organizations have participated in the project including Imperial County, U. S. Environmental Protection Agency, U.S. Fish and Wildlife Service, California Department of Fish and Game, and Citizen Congressional Task force on the new River. The areas have also become small ecosystems and have attracted birds and some fish. They have also become popular fishing spots for local area residents.

### **Salton Sea**

The Salton Sea is in an internal basin in Imperial and Riverside counties. It was created more than 100 years ago by a levee break in the Colorado River. Presently, the Salton Sea has a surface area of 365 square miles and 105 miles of shoreline. The elevation of the water surface is about 232 feet below sea level. One of the major functions of the Salton Sea is to serve as a sump for agricultural tailwater and for urban treated and untreated wastewater flows from the Imperial and Coachella valleys and Mexico. Although its reputation for recreation and sports fishing has diminished in recent years, the sea still provides critical habitat for migratory birds in the Pacific Flyway. The Sonny Bono Salton Sea National Wildlife Refuge is an important wetland area. Because drainage is internal, salts tend to concentrate in the sea's water, and the nutrients enhance the formation of eutrophic conditions<sup>1</sup>.

The sources of water for the Salton Sea are agricultural surface tailwater and tile drain water, operational spills, treated and untreated municipal and industrial wastewater, and urban runoff from the Imperial Valley, Coachella Valley, and the Calexico Valley in Mexico. From Imperial County and Mexico, the New and Alamo rivers—fed by the agricultural drains in the Imperial Valley and discharge to Mexico—provide most of the flows that drain into the sea. There are water quality concerns about the untreated and partially treated municipal and industrial wastewater flows that originate in the Calexico Valley and come into the United States through the New River, as well as the presence of pesticides, nutrients, selenium, and silt in the agricultural tailwater, tile drain water, and seepage flows. From the north, the Whitewater River provides agricultural tailwater and tile drainage flows and urban runoff.

Salt Creek, which drains portions of the Orocopia and Chuckwalla mountains to the east of the sea, and Whitewater River provide some freshwater inflows to the Salton Sea.

### ***San Felipe Creek, Fish Creek, Vallecito Creek, and Carrizo Creek Watersheds***

The watersheds associated with San Felipe, Fish, Vallecito, and Carrizo creeks are within and outside of the Anza-Borrego Desert State Park in eastern San Diego County with portions extending into Imperial

County and north into Riverside County. These areas provide natural habitat for migratory birds and other wildlife, including 12 State- or federal-listed rare, threatened, or endangered species. Including land within the State park, the combined watersheds cover over 700,000 acres.

The riparian areas have been identified as key habitat for the birds and other wildlife. These include the natural groves of the California Fan Palms, mesquite woodland, and wet meadows or marshes. Management efforts are under way to preserve and improve the critical habitat areas, which include removal of invasive plant species to allow the native plants and animals to redevelop.

### *Other Watersheds*

Watersheds have been recognized in the Colorado River, Twentynine Palms-Lanfair, and Chuckwalla PAs. For the Colorado River PA, watersheds include the Havasu-Mojave Lakes, Piute Wash, Imperial Reservoir, and the Lower Colorado River; these watersheds extend eastward into Nevada and Arizona. Scattered urban land uses exist in each watershed. Agricultural uses are prominent in the Imperial Reservoir and Lower Colorado River areas. Minor water quality concerns are in the Havasu-Mohave Lakes and Piute Wash areas.

The Southern Mojave watershed is in both the Twentynine Palms-Lanfair and Chuckwalla PAs. Portions of the San Bernardino and San Jacinto mountains and several smaller mountain ranges provide most of the boundaries for this watershed. Much of the watershed is devoid of urban and agricultural land uses. The exceptions are Lucerne Valley, which has urban areas and agriculture, and Yucca Valley, which has urban areas exclusively.

Describe the major or significant watersheds of the region. This should also include a description of existing interregional or interstate ties that the watersheds may have.

## **Groundwater Aquifers**

[Placeholder: Groundwater content being developed including:

- Brief physical description of the significant alluvial and fractured rock (if applicable) aquifer systems within the Hydrologic Region.
- Brief description of the priority groundwater basins within the Hydrologic Region.
- Table showing the groundwater basins and subbasins within the Hydrologic Region, by their priority designations.
- Map showing the groundwater basins and subbasins within the Hydrologic Region, by their priority designations.
- Brief discussion of the well infrastructure, with an explanation of the data gaps associated with this important dataset.
- Brief and general discussion of groundwater occurrence and movement, and identification of key recharge and discharge areas, subject to availability of information.
- Map showing groundwater elevation contours with arrows depicting general direction of groundwater movement, subject to availability of information.]

## **Ecosystems**

### *Salton Sea*

Serving as wintering habitat for both migratory and shoreline birds, ranging in number from hundreds of thousands to the low one million, are the Sony Bono Salton Sea National Wildlife Refuge and the Wister

Unit of the Imperial Wildlife Area. The SBSSNWR, which was established in 1930, is located on the southern shores of the Salton Sea. There are 830 acres of land maintained as wetlands with an additional 870 acres planted to forage crops such as alfalfa, wheat, rye grass, and sudan grass. The habitat was created for the endangered Yuma Clapper Rail and American Avocet. The WUIWA is located on the southeastern shore and occupies a little more than 7,900 acres of land. It includes salt marshes, freshwater ponds, and native, undeveloped lands.

The California Legislature enacted legislation in 2003 that directed the California Resources Agency (now the Natural Resources Agency) to prepare a restoration study and a programmatic environmental document to explore ways to restore important ecological functions of the Salton Sea (Sea) and to develop a preferred restoration alternative. The Salton Sea Ecosystem Restoration Program Programmatic Environmental Impact Report (PEIR) was completed in 2007. The Secretary of the Resources Agency, based on the information contained in the PEIR, recommended a preferred alternative to the Legislature for ecosystem restoration.. To date, the Legislature has not provided funding to implement the preferred alternative. In 2010, the Legislature enacted Senate Bill 51 (Ducheny) which established the Salton Sea Restoration Council as a state entity under the Natural Resources Agency to oversee the restoration of the Salton Sea. However, the Legislature has not yet appropriated funds for the Council and is debating eliminating the Council altogether.

### **Salton Sea Species Conservation Habitat Project**

Habitat values at the Salton Sea have continued to decline as salinity increases and water levels recede. To address the near-term loss and degradation of habitat during the period prior to implementation of a larger restoration plan, the California Legislature appropriated funds for the purpose of implementing conservation measures necessary to protect the fish and wildlife species dependent on the Salton Sea. The California Department of Fish and Game was given authority, under Fish and Game Code 2932, to pursue this objective. This began in 2009 the Species Conservation Habitat Project (SCH) to create approximately 2,400 acres of shallow pond habitat at the Sea to support fish populations which in turn would support bird populations.

The Legislature has appropriated \$5.4 million in Proposition 84 (Chapter 5) funds for the SCH Project. An additional \$20 million in Proposition 84 funds will need to be appropriated and placed in the Salton Sea Restoration Fund for completion of the project. The Salton Sea Mitigation Fund (up to \$30 million) would be used for operations and maintenance of the project. Through the Salton Sea Financial Assistance Program (FAP) stakeholders can participate in the restoration process of the Salton Sea using funds provided by Proposition 84. The FAP will provide grants to eligible applicants (local agencies, nonprofit organizations, tribes, universities, and State and federal agencies) for projects that conserve fish and wildlife within the Salton Sea ecosystem.

Along the Colorado River, two wildlife ecosystems coexist; the Imperial national Wildlife Refuge and Cibola National Wildlife Refuges. Both facilities occupy land in California as well as in Arizona. Lush riparian habitats have been established in both refuges, creating important habitat for both permanent and migratory birds and other wildlife.

A number of wilderness areas have been established in the Colorado River Hydrologic Region. These federally-designated areas are managed by one of the following federal agencies, USBLM, USFES, or the USFS. Some of the larger designated areas are in the southern portion of the Mojave Desert Preserve.

These include the Turtle Mountain Wilderness Area (177,000 acres) and the Palen-McCoy Wilderness Area (259,000 acres). The latter is known for its desert ironwood trees. Other wilderness areas exist along the Colorado River. These include the Chemehuevi Mountains and Big Maria Mountains wilderness areas.

#### *Coachella Valley Multiple Species Habitat Conservation Plan*

In 2008, the USFWS and CDFG both issued permits for the Coachella Valley Multiple Species Habitat Conservation Plan. To implement the action items in the plan, The Coachella Valley Conservation Commission was formed which is comprised of representatives from State, County, and City agencies and other important organizations. Work is underway to develop and approve management plans and monitor activities for six environmental areas identified in the plan. Management activities would include the acquisition of land, strategies for the protection of endangered species and their habitats, and strategies to mitigate impacts from regional climate change.

#### *Lower Colorado River Basin Multi-Species Conservation Program*

Since 2005, new habitat is being established in the Palo Verde Ecological Preserve. This includes the planting of new trees and shrubs which include cottonwood trees, several varieties of willow trees, and mesquite. Surveys are underway to determine the number of birds and land animals which live in the preserve. Over 700 acres of new habitat have been established to date. Future projects include the identification and establishment of ponds off of the main channel of the Colorado River. These would provide aquatic habitat for razorback sucker, bonytail, and flannel mouth sucker fish species.

#### *Mojave Desert Natural Reserve*

The southeastern portion of the Mojave Natural Preserve is located in the Twentynine Palms-Lanfair PA. Despite the arid conditions, a diverse collection of animals and plants have been able to settle and continue to flourish in the preserve. Natural seeps and springs are sufficient enough to support the native vegetation. This includes yucca, creosote bush, cactus, relict white firs and chaparral, and the Joshua tree. The vegetation provides habitat to numerous animals and birds, including the Big Horn Sheep, desert tortoises, hawks, and eagles.

#### *Environmental and Habitat Protection and Improvement*

Elements of the biological mitigation measures from the Imperial Irrigation District's (IID) 2002 Draft Habitat Conservation Plan are being used as the agency implements its Water Conservation and Transfer Project in compliance with the provisions of the Colorado River Water Delivery Agreement: Federal Quantification Settlement Agreement of 2003 (federal QSA). The measures are required under the existing incidental take authorizations pursuant to the Endangered Species Act (ESA) and California Endangered Species Act (CESA). The IID is now preparing the Habitat Conservation Plan (HCP) and Natural Communities Conservation Plan (NCCP) that will contain modified or new mitigation and conservation measures not included in the 2002 Draft HCP and not evaluated in the Transfer Project Final Environmental Impact Report/Environmental Impact Statement (EIR/EIS).

In 2012, the IID and USFWS announced plans for the joint preparation of the Subsequent EIR/Supplement EIS to the Final EIR/EIS for the IID Water Conservation and Transfer Project. The document will evaluate proposed changes to the Transfer Project and modifications to the mitigation requirements in the Transfer Project, the draft 2002 Habitat Conservation Plan, and draft Natural Community Conservation Plan.

## Climate

Most of the Colorado River Region has a subtropical desert climate with hot summers and short, mild winters. The mountain ranges on the northern and western borders, in particular the San Bernardino and San Jacinto mountains, create a rain shadow effect for most of the region. Annual rainfall amounts range between a little over 6 inches to less than 3 inches. Most of the precipitation for the region occurs in the winter and spring. However, monsoonal thunderstorms, spawned by the movement of subtropical air from the south, do occur in the summer and can generate significant rainfall in some years. Higher annual rainfall amounts and milder summer temperatures occur in the mountains to the north and west. Clear and sunny conditions typically prevail, and the region receives 85 to 90 percent of the maximum possible sunshine each year; the highest value in the United States.

Table CR-1 presents annual averages of maximum and minimum temperatures and annual totals of precipitation as measured by weather stations of the California Irrigation Management Information System for 2005 through 2010 in the Colorado River region. Maximum and minimum temperatures and reference evapotranspiration values remained very stable during the period. Measured rainfall during the 2006-2009 period reflected the dry hydrologic conditions in the region and roughly corresponds with the conditions that existed Statewide. During the period, the region was not impacted by the normal frequency of summer monsoonal thunderstorms; it was unusually quiet. However, the lack of rainfall does not impact planting decisions by farmers in the region.

### **PLACEHOLDER Table CR-1 Colorado River Hydrologic Region Annual Averages of Temperatures and Precipitation**

[Any draft tables, figures, and boxes that accompany this text for the advisory committee draft are included at the end of the report.]

The Colorado River Hydrologic Region population in 2010 was 747,100. This is a 23 percent increase in the population from 2000, but only a 5 percent increase from 2005. The slower growth in the last 5 years is a reflection of the serious impacts of the recession. In 2010, about 83 percent of the population in the region was located in the Coachella Valley (459,200 or 61 percent) and Imperial Valley (165,600 or 22 percent) planning areas. Of the remaining 122,300 residents, the Twenty-nine Palms/Lanfair PA had 73,100.

In the Coachella Valley, many of the residents reside in the golf- and resort- cities in the northwest portion of the valley. These include Cathedral City (2010 population - 51,200), Palm Desert (2010 population - 48,400), Palm Springs (2010 population - 44,600), Coachella (2010 population - 40,700), Banning (2010 population - 29,600), and Desert Hot Springs (2010 population - 25,900). In the southeast, the cities provide more service support for the surrounding agricultural operations; included are Indio (2010 population - 76,000) and Coachella (2010 population - 40,700).

In the Imperial Valley, cities and towns also provide support for the major agricultural operations throughout the area. Also, consumer services are provided for residents and businesses in the Mexicali Valley across the international border with Mexico. Important cities include El Centro (2010 population - 42,600), Calexico (2010 population - 38,600), Brawley (2010 population - 24,950), and Imperial (2010 population - 14,800).

In the Homestead and Coyote Valleys in the Twenty-nine Palms\Landfair PA, growing cities include Yucca Valley (2010 population – 20,700) and Twenty-nine Palms (2010 population – 25,068).

In the Colorado River PA, the City of Blythe (2010 population - 20,800) provides support for the agricultural operations in the Palo Verde Valley. In the north is the City of Needles (2010 population – 4,800) in the Mohave Valley. Although there are no incorporated cities, the community of Winterhaven and the widely-dispersed residents in the Bard Valley, west of Yuma, Arizona, have about 3,200 permanent residents.

### **Land Use Patterns**

Despite the extremely arid conditions, three of southern California's major agricultural areas are located in the Colorado River region. These are Imperial Valley (Imperial PA), Coachella Valley (Coachella PA), and the Palo Verde and Bard Valleys (Colorado River PA). The warm winters allow for an all-year regimen, and reliable water and good soils allow a wide range of permanent and annual crops, including table grapes, dates, citrus, vegetables of all kinds, and field crops, including alfalfa, wheat grain, Bermuda and Klein grass, and cotton. Multiple cropping is widely utilized. Even livestock is an important product, particularly cattle and sheep. The region, particularly the Imperial Valley, is a valuable component in the nation's agricultural scheme.

Total irrigated land in the Colorado River region was 577,870 in 2009, with a total crop production from 650,130 acres, indicating more than 72,000 acres multiple-cropped. By comparison, 587,000 acres of land were under cultivation in 2005, with 659,320 acres of total product (reductions of 1.5 percent and 1.4 percent, respectively). This relative stability of the last five years has come after Imperial and Palo Verde valley land-fallowing programs in the previous five years had reduced the region's acreage by up to a sizable 40,000 acres. The land fallowing program in Imperial Valley helps IID meet water transfer obligations from the federal QSA, while land fallowing in Palo Verde Valley is a result of an agreement between the Metropolitan Water District of Southern California (MWDSC) and the Palo Verde Irrigation District (PVID).

Table CR-2 shows the harvested acres of the top six crops in the Colorado River region in 2009.

#### **PLACEHOLDER Table CR-2 Top Six Crops of Colorado River Hydrologic Region, 2009 (Acres)**

[Any draft tables, figures, and boxes that accompany this text for the advisory committee draft are included at the end of the report.]

With more than 430,000 acres of irrigated cropland in 2009, Imperial Valley continues to be the most productive PA in the region. Over 50,000 acres of vegetables are harvested annually, allowing for the valley to be identified as the nation's winter vegetable wonderland. Because of the extreme summer heat, vegetable production is dominated by winter- and spring- harvested lettuce, broccoli, carrots, cantaloupes, and onions, but many other crops are cultivated and do very well in the valley.

Livestock forage and field crops are also very important in the Imperial Valley. The valley's most significant acreage was for alfalfa and other field crops; in 2009; 114,000 acres for alfalfa, 105,000 acres for wheat and other grains, 75,000 acres of Bermuda and Klein grass, and 37,000 acres of Sudan grass. Classified as a field, local farmers harvested 19,000 acres of sugar beets for the same year; most of which

is processed for sugar at a local refinery. Annual variations in the planted and harvested acreage for the various crops in the valley do occur, depending on anticipated and actual market conditions. Cotton was very important in Imperial Valley in the 1980s, however, only 9,000 acres was planted in 2005 and less than 800 acres in 2009.

About 20 percent of the harvested alfalfa and forage crop acres was consumed locally by the 370,000 head of cattle corralled in the valley's feedlots in 2009. In fact, cattle was the biggest money-making agricultural commodity in the valley, with a gross value of \$287,000,000 in 2009, nudging out the combination of head and leaf lettuce, which together had a gross value of \$262,000,000. Valley livestock operations also included 140,000 head of sheep.

Agriculture is quite different in the Coachella PA than in the Imperial PA. Climate-wise, the valleys are nearly identical. However, there is less land under irrigation in Coachella Valley; about 48,000 acres was under cultivation in 2009. In terms of crops, nearly three-quarters of the land is devoted to citrus, dates, and vineyards, with alfalfa and grain crops almost negligible. A variety of vegetables crops are grown, including peppers, but only a relatively small amount of lettuce. Dates are probably the most distinctive Coachella crop, with date palm groves covering 8,100 acres and a gross value of \$33 million in gross sales in 2009. However, the PA's most important crop is several varieties of table grapes, including the Flame seedless. In 2009, about 14,000 acres of grape vineyards are under cultivation which resulted in \$114 million in gross sales. Harvested citrus fruit netted \$63 million in sales.

The third important agricultural area is the Colorado River PA. Agricultural operations occur mostly in the Palo Verde Valley (70,000 acres of irrigated land), but also occur in the Mohave Valley, which is north of the City of Needles (3,700 acres of irrigated land), and in the Bard Valley in the southeast corner of California, west of Yuma, Arizona (16,000 acres of irrigated land). Cropping patterns in each area are different. In the Palo Verde Valley, alfalfa was cultivated on over 50,000 acres which is more than half of land under cultivation annually. Cotton remains important with more than 7,000 acres planted for 2009. In the Mohave Valley, alfalfa and field crops are the principle crops, with small acres of cotton and grain crops. Winter vegetables, citrus fruit, and dates are important in the Bard Valley. In 2009, more than 13,000 acres of vegetable crops were planted and harvested on just 16,000 acres of land. Dates are also important in the Basin Valley with more than 1,000 acres harvested annually.

Two other smaller agricultural production centers in the region include the approximately 3,100 acres of citrus fruit orchards and nursery-grown palms in Borrego Valley in eastern San Diego County, and the 1,000 acres of citrus and vineyards in Cadiz Valley in east-central San Bernardino County.

Most of the urban land uses for the Colorado River region are in the Coachella, Imperial Valley, and Twenty-nine Palms/Lanfair planning areas, with the heaviest concentration in Coachella PA. The uses include single-family and multi-family dwellings, strip malls and shopping centers, and public and private country clubs and golf courses. In the Coachella Valley, most of the older uses are located on or near State Highway 111. The urban area expanded at a steady pace from this core to the north and southeast for more than 2 decades in support of recreation and tourism, particularly golf. However, the pace of expansion slowed noticeably about 3 years ago in response to the recent recession. In the Imperial Valley and southeastern portion of the Coachella Valley, the commercial and industrial uses in the cities generally support local agricultural operations; packing houses and farm equipment sales and repairs. In

addition, the residential and commercial lands in the Imperial Valley have undergone some expansion in support of new homeowners and consumers both locally and from the Mexicali Valley in Mexico.

Naval and military training facilities and other preserved or managed public lands are conspicuous in the region, including several large national and State parks, recreation and wilderness areas, and wildlife refuges. Indian tribes and associated reservations also maintain a significant presence. Indian-operated casinos and resorts along the Colorado River north of Needles, north of the City of Palm Springs, and near the community of Cabazon west of Palm Springs are a convenient alternative for southern Californians who enjoy the attractions of Las Vegas, NV.

Nationally known parks in the region include Joshua Tree National Park, the Mojave National Scenic Preserve, Anza-Borrego State Park, and the Salton Sea and Picacho State Recreation areas. Several units are also set aside for preservation or other land management purposes, including national recreation and wilderness areas, wildlife refuges, tribal reservations, and US Navy facilities.

### **Tribal Communities**

[Describe tribal communities that exist in the region.]

### **Tribal Lands**

A Native American tribe may be federally recognized, and the federal government may set aside lands for Tribes as reservations. In California these reservations are often named “Rancherias.” One interpretation of the Spanish term Rancheria is small Indian settlement. Granted tribal lands are listed in Table CR-3.

### **PLACEHOLDER Table CR-3 [Title to Come]**

[Any draft tables, figures, and boxes that accompany this text for the advisory committee draft are included at the end of the report.]

### **Regional Resource Management Conditions**

[This subsection contains a discussion of the following topics. (Primary authors are regional entities who wish to partner with Regional Office staff, the water supply and balances work team, the integrated flood management work team, and the ecosystem planning work team.)

- A characterization of environmental water use and demands.
- Water portfolios (1998-2009).
- Change in groundwater storage.
- An updated write-up from the Update 2009 regional report flood appendix.]

[Sources of this information may be IRWM plans, statewide flood management planning report, groundwater enhancements, local agency, and portfolio data; Bulletin 118, State Water Resources Control Board, and Department of Public Health data; U.S. Army Corps of Engineers, Division of Flood Management, Federal Emergency Management Agency, Federal Energy Regulatory Commission [FERC], National Marine Fisheries Service, and operations criteria and plan [OCAP] reports; and FERC licenses.]

[Considerations for this subsection:

- Quantify water supplies, uses, quality, imports, and exports.
- Estimate uses by source, uses by sector, and other subcategories based on documented assumptions.
- If possible, indicate the level of uncertainty for reported data.
- Identify wild and scenic rivers, instream flow and Delta outflow requirements, etc.
- Describe water supply sources (groundwater, surface, recycling, desalination, regional imports, etc.) and water rights.
- Summarize agricultural, urban, and managed wetland water use.
- Compare water use and supply parameters to show effects on water availability for beneficial uses (change over time, relative fractions of total, use rates for each region, and correlated factors).
- Summarize water quality conditions.
- Describe flood management systems, risks, procedures, and responsibilities.
- Summarize key operational criteria for large regional water projects.
- Governance summary: Identify responsibility of local governments, tribal government, agencies, and institutions for managing water resources, flood protection, and wastewater.
- Provide links to detailed information in the reference guide.
- Describe tribal participation in regional resource management.]

## Water in the Environment

[Placeholder: Groundwater content being developed including:

- Description of the groundwater related environmental issues for the Hydrologic Region based on connection, disconnection, or seasonal connection between the aquifer groundwater table and the local surface water systems (including wetlands), subject to availability of data.
- Description of the importance of protecting groundwater recharge areas, and potential environmental consequences associated with contaminated aquifers.]

## Environmental Water

The largest water body in the region is the Salton Sea, a saline body of water about 50 feet deep. The concentration of total dissolved solids in the sea is about 46,000 milligrams per liter, which is about 40 percent greater than that of ocean water. Most of the environmental applied water demands in the region are for the Sonny Bono Salton Sea National Wildlife Refuge, DFG's Imperial Wildlife Area, and wetland areas on the shore of the Salton Sea; and to maintain the viability of the sea under the federal QSA through 2017. IID continues to fallow fields each year to meet Salton Sea mitigation conditions identified in the IID/San Diego County Water Authority (SDCWA) Water Transfer, which was approved under the federal QSA.

The Salton Sea ecosystem remains a critical link on the international Pacific Flyway,. It provides wintering habitat for migratory birds, including some species whose diets are based exclusively on fish. For the California Water Plan Update 2009, the expected average annual inflows to the Salton Sea for a 25-year time frame was expected to be about 962,000 acre-feet per year, based on estimates using the Salton Sea Accounting Model (SSAM).

Water supplies are delivered to the Sonny Bono Salton Sea National Wildlife Refuge Complex, the Imperial Wildlife Area and Wister Unit, and some private wetlands in the Imperial Valley PA. For 2009, about 30.3 TAF was delivered to these areas.

## Water Governance

The Colorado River is an interstate and international river with use apportioned among the seven Colorado River Basin states and Mexico by a complex body of statutes, decrees, and court decisions known collectively as the “Law of the River.” The following tables describes the legal mandates governing the uses of the River by California: Table CR-4 Key elements of the Law of the River; Table CR-5 “Annual intrastate apportionment of water from the Colorado River mainstream within California under the Seven Party Agreement,” and CR-6 “Annual Apportionment of Use of Colorado River Water Interstate/International. For the QSA, Table CR-7 shows the 2010 “Quantified Net” and “Actual Net” Consumptive Uses for each of the Colorado River users.

### **PLACEHOLDER Table CR-4 Key Elements of the Law of the Colorado River**

[Any draft tables, figures, and boxes that accompany this text for the advisory committee draft are included at the end of the report.]

### **PLACEHOLDER Table CR-5 Annual Intrastate Apportionment of Water from the Colorado River Mainstream within California under the Seven Party Agreement<sup>a</sup>**

[Any draft tables, figures, and boxes that accompany this text for the advisory committee draft are included at the end of the report.]

### **PLACEHOLDER Table CR-6 Annual Apportionment of Use of Colorado River Water Interstate/International**

[Any draft tables, figures, and boxes that accompany this text for the advisory committee draft are included at the end of the report.]

### **PLACEHOLDER Table CR-7 Colorado River Water Delivery Agreement: Federal Quantification Settlement Agreement of 2003 for Priorities 1-3 — Quantification and Annual Approved Net Consumptive Use of Colorado River Water by California Agricultural Agencies**

[Any draft tables, figures, and boxes that accompany this text for the advisory committee draft are included at the end of the report.]

## Water Governance

Legal challenges were made against the Quantification Settlement Agreement. In all, 11 lawsuits were filed, but 5 were dismissed and the remaining litigation was consolidated for trial. In 2010, the trial court ruled that an important agreement in the QSA, the QSA Joint Powers Agreement, was invalid because of a violation related to the appropriation clause (article XVI, section 7) of the California Constitution. This ruling also invalidated 11 other agreements in the QSA. However, in late 2011, the Third District Court of Appeal reversed the trial court ruling and permitted the water agencies to continue with the QSA implementation. In early 2012, the California Supreme Court declined to hear arguments for the lawsuits. It should be noted that the Court of Appeal ruling did order some of the litigation back to the trial court for further proceedings.

Two groundwater basins in the region are bound by adjudication judgments: the Warren Valley and Beaumont groundwater basins.

The Warren Valley Groundwater Basin adjudication judgment was finalized in 1977. The court appointed Hi-Desert Water District as the watermaster and ordered the agency to develop a plan to halt the overdraft of the basin. In 1991, the Warren Valley Basin Management Plan was released with recommendations that included managing extractions, importing water supplies, conserving storm water flows, encouraging water conservation and recycling, and protecting the quality of the groundwater supplies.

The Beaumont (Groundwater) Basin adjudication judgment was finalized in 2004. The Superior Court appointed a committee to serve as the watermaster. The committee includes representatives from the cities of Banning and Beaumont, Beaumont-Cherry Valley Water District, South Mesa Mutual Water Company, and the Yucaipa Valley Water District. The judgment established the annual extraction quantities for the parties that were classified as either overlying owners or appropriators.

[Placeholder: Groundwater content being developed including:

- Discussions of the various governance approaches to groundwater management within the Hydrologic Region and identification of specific GWMPs, IRWM Plans, groundwater ordinances, and adjudicated groundwater basins within the Hydrologic Region.
- Table listing the GWMPs, IRWMPs, groundwater ordinances, and adjudicated groundwater basins.
- Maps showing area coverage for GWMPs and IRWMPs, and “dot” locations of groundwater ordinances and adjudicated basins.]

## Water Supplies

Urban, agricultural, environmental, and energy water demands in the Colorado River region are met with surface water supplies from the Colorado River, groundwater, and recycled water. Water supplies from the Colorado River meet all or portions of the agricultural and urban water demands in the Imperial, Palo Verde, Coachella, and Bard valleys. The PVID operates facilities which divert water supplies from the Colorado River for its agricultural customers. For the Bard Valley, Colorado River water supplies are diverted to the area through the Yuma Project facilities, which are operated by the USBR. Colorado River water supplies are transported to the IID through the All-American Canal for its agricultural customers and for the urban customers of the public and investor-owned water agencies in the valley. The recently concrete-lined Coachella Canal transports river water, taken at Drop 1 along the All-American Canal, into the Coachella Valley for agricultural and some urban uses. The Colorado River is an interstate and international river with use apportioned among the seven Colorado River Basin states and Mexico by a complex body of statutes, decrees, and court decisions known collectively as the “Law of the River.” (Table CR-2 Key elements of the Law of the River; Table CR-4 Annual intrastate apportionment of water from the Colorado River mainstream within California under the Seven Party Agreement).

Total water supplies required to meet the demands in the Colorado River region between 2006 and 2009 ranged from 4,533 TAF to 4064 TAF. Over 80 percent of the totals for each year were met by Colorado River supplies. Groundwater supplies were slightly less than 10 percent of the totals.

Many of the alluvial valleys in the region are underlain by groundwater aquifers that are the sole source of water for local communities and farming operations. Not all groundwater sources are suitable for potable

uses because of water quality issues. In the Coachella Valley, public agencies such as Desert Water Agency (DWA) and Mission Springs Water District (MSWD) and private parties pump groundwater to meet urban and agricultural water demands. Groundwater is used to meet much of the urban demand along the Colorado River, serves as the sole source of water for the urban and agricultural users in the Borrego Valley and the community of Desert Center, and supports the agricultural operation in the Cadiz Valley.

The State Water Project (SWP) and recycled and local surface water supplies provide the remainder of water to the region. SWP supplies are obtained through an exchange agreement between the Coachella Valley Water District (CVWD), DWA, and MWDSC. No facilities exist today to deliver SWP supplies to the Coachella Valley contractors. However, through the agreement, the MWDSC releases the combined SWP allocations for the CVWD and DWA into the Whitewater River from its Colorado River Aqueduct. These releases recharge the upper groundwater basin of the Coachella Valley and the Salton Creek groundwater basin. In exchange, MWDSC receives the agencies' annual allocations through SWP facilities. The CVWD treats urban wastewater flows and makes the recycled water supplies available for non-potable uses such as irrigations of golf courses.

The CVWD and DWA continue work with water agencies outside of the region to augment its SWP deliveries and assist with local groundwater management activities. In addition to the advanced delivery of Colorado River water, CVWD, DWA, and MWDSC agreed to the terms of a second agreement, the 2003 Exchange Agreement. MWDSC transferred 100 TAF of its SWP allocation to both agencies; 89 TAF to CVWD and 11 TAF to DWA. In 2007, the agencies agreed to transfer agreements with the Berenda Mesa Water District and the Tulare Lake Water Basin Storage District for the transfer of additional SWP supplies; for 16 TAF and 7 TAF respectively. CVWD has also entered into agreements for the one-time transfer of non-SWP water supplies to its service area with the Rosedale-Rio Bravo Water Storage District, for banked Kern River flood waters and DMB Pacific, Inc. for "nickel" water from the Kern County Water Agency's Kern River Restoration and Water Supply Program.

[Placeholder: Groundwater content being developed including:

- Description of the major agricultural and municipal areas served and trends in the water use met by groundwater supply, such as more or less reliance on groundwater supply over time.
- Map illustrating the location of major water use met by groundwater supply.
- Table illustrating the trends in water use met by groundwater supply.
- Description of seasonal and long-term groundwater level trends, an overview of groundwater supply sustainability based on existing management considerations, and groundwater change in storage, subject to availability of information.
- Charts of selected well hydrographs illustrating the variability, challenges, and successes in groundwater management in the Hydrologic Region.]

## Groundwater

Between 2006 and 2009, groundwater provided between 8 and 9 percent of the region's applied water supply in normal years. Groundwater storage capacity has been estimated for 40 of the region's 57 groundwater basins and totals more than 175 million acre-feet. The groundwater beneath the agricultural area of the Imperial Valley is too saline to be used without treatment.

The most important groundwater basin in the Colorado River is the Coachella Valley Groundwater Basin in the Coachella Planning Area. This basin has 5 sub-basins, San Geronio Pass, Whitewater, Garnet Hill, Mission Creek, and Desert Hot Springs. The largest of the sub-basins is the Whitewater. Although there is no physical boundary, the Whitewater Basin is divided into two basins, Upper Whitewater River Sub-basin Area of Benefit (AOB) and the Lower Whitewater River AOB. Although the Whitewater basin is not adjudicated, the upper basin is managed by the Coachella Valley Water District and Desert Water Agency. The lower basin is managed by CVWD.

Agreements remain that allow local water districts in the Coachella Valley to reduce the decline in groundwater levels resulting from overdraft. The agreement between CVWD and DWA to bring SWP supplies into the valley was an important step. In 1984, another agreement was reached among CVWD, DWA, and MWDSC for water banking which allowed for advanced deliveries of Colorado River water into the Coachella Valley during periods of high flows on the river. These supplies helped speed the pace of groundwater replenishment of the basin and provided water for future uses. However, groundwater levels continue to decline in much of the basin.

Under the 1984 agreement, MWDSC was permitted to bank up to 600 thousand acre-feet of surface water in the groundwater basin. When withdrawals were required, MWDSC would use its Colorado River surface water along with SWP allocations from CVWD and DWA, and CVWD and DWA would use the banked groundwater until the volume stored under this agreement was depleted.

The Warren Valley Basin had also seen significant groundwater overdraft and declining groundwater levels. The Mojave Water Agency constructed a 71-mile pipeline from the California Aqueduct near the City of Hesperia to serve the communities of Landers, Yucca Valley, and Joshua Tree. The Hi-Desert Water District has been taking water from the pipeline since 1995 to recharge the previously overdrafted Warren Valley Basin. The area had been under court ordered development limitations before the pipeline was completed.

The Borrego Valley Basin in San Diego County is the sole source of supply for the local urban and agricultural water users. Groundwater levels have been falling steadily since the 1950s.

The Twentynine Palms Groundwater Basin lies beneath the City of Twentynine Palms, the US Marine Corps facility, and Mesquite Lake. Groundwater levels are generally stable.

## Water Uses

In California, the Seven Party Agreement of 1931 established local agencies' apportionments of Colorado River water, which were further defined in the federal QSA of 2003. In accordance with the terms of the October 2003 Colorado River Water Delivery Agreement (CRWDA): Federal QSA, IID delivery for agricultural water use is expected to be reduced in future years (Table CR-8).

### **PLACEHOLDER Table CR-8 [Title to Come]**

[Any draft tables, figures, and boxes that accompany this text for the advisory committee draft are included at the end of the report.]

Urban and agricultural water demands in the Colorado River Hydrologic Region ranged from 4,150 TAF to 3,650 TAF between 2006 and 2009. Total demands decreased slightly in 2009 probably because increased water use efficiency program activities and the recent recession.

About 85 percent of the total demands in the region came from agriculture for the 2006-2009 period, and a majority of that was from the Imperial Valley PA. Total applied water demands for agriculture ranged between 3,490 TAF and 3,109 TAF. In the Colorado River PA, agricultural demands were lower for the period than before 2005. This is due to the water transfer agreement between the PVID and MWDSC that resulted in the fallowing of about 20 percent of the fields.

More than half of the urban demands in the Colorado River region occurred in the Coachella Valley PA between 2006 and 2009. Total applied water demands for urban ranged between 659 TAF and 546 TAF; included were imported supplies used for the recharge of groundwater basins. Most all of the demands were met through groundwater supplies. In the Imperial Valley and for some water users in the southern Coachella Valley PA, Colorado River supplies are utilized.

Crops in the Colorado River region are irrigated with traditional or new irrigation systems. As for the traditional, furrow irrigation is still the standard for the Palo Verde and Imperial valleys. Siphon tubes and head ditches are common as water is applied to the vegetables, sugar beets, and cotton from a network of head ditches and field laterals. It should be noted that farmers use hand-move sprinkler systems to handle the irrigation of vegetables for seed germination and for the first several weeks of growth. In addition, the use of plastic mulch more frequently on the planting beds to regulate warmth and moisture for some vegetables, including certain varieties of melons, is becoming more frequent. Border-strip systems continue to be used for alfalfa, grain, and sudan, bermuda, and klein grasses. Furrow irrigation for alfalfa was successfully introduced a few years ago and now is an accepted approach for about one-third of the alfalfa acres in Imperial Valley. In the past decade, we have seen increased planting of wide-bed lettuce and spinach in both valleys; irrigation is handled almost exclusively by hand-move sprinklers.

Irrigation operations are a bit different in Coachella Valley. Both traditional and newer irrigation system technology are in use. For truck and field crops, it is common to see these crops irrigated with hand move sprinklers for seed germination and early stages of growth. Farmers will then switch to furrows to handle the irrigations until harvest. However, more farmers are using subsurface drip irrigation systems, buried plastic drip lines, to handle the irrigations through the entire growing seasons. Bell and other varieties of peppers are often irrigated this way. Mature date trees in the Coachella Valley are mostly irrigated with large, wide furrows. But drip systems are now being used for many of the younger trees. Citrus trees and grape vineyards are irrigated exclusively with drip systems. For the vineyards, the drip lines are attached to the trellises about two feet above the ground. Also, many of the vineyards have a system of sprinklers perched above the plants that are used to minimize damage caused by extreme climate conditions such as frost. Center pivot systems are only being used in the Mohave Valley for field crops.

Although water supplies are reliable and inexpensive, water agencies, farmers, and urban users in the region are fully aware of the need to manage and use those supplies efficiently. In agriculture, this includes improving the distribution uniformity of irrigation water being applied and applying water when needed. The expansion of use of surface and subsurface micro-irrigation systems has been an important step towards meeting this goal. Even the traditional irrigation systems (furrows, border-strip, and sprinklers) are being operated to minimize losses caused by evaporation, excessive tailwater runoff, and

deep percolation. Laser-leveling, particularly for many of the fields in Imperial Valley, has been important in the improving the operational efficiencies of these systems.

All operations are benefiting from the technical services on irrigation management issues provided by the local water (IID, CVWD, PVID, and USBR) and government (NRCS and UCCE) agencies. To assist those farmers who are currently scheduling the irrigations for the crops, these agencies continue to work with DWR to provide adequate coverage of the region's climatology with weather stations of the CIMIS network. All of the major agricultural areas in the regions are now adequately covered by CIMIS stations. With a vastly improve internet, farmers feel at ease to access the real-time climate data being measured by the stations and utilize them in their irrigation operations.

For the urban water users in the region, water agencies are implementing many of the Urban Best Management Practices programs and policies. Many of the agencies provide speakers and distribute and post water use efficiency information as part of their public and school water education programs. The CVWD and Indio Water Authority provide indoor water use efficiency kits for local homeowners. The IWA has started and the Mission Springs Water District (MSWD) will soon provide home survey services for their residential customers. The CVWD has several rebate programs. It recently began one for homeowners for the installation of High Efficiency Toilets. The other program provides financial assistance to homeowners seeking to convert their exterior landscape from a turf grass dominant design to one that emphasizes water-efficient plants; the IWA has a similar program.

In compliance with Water Conservation in Landscaping Act, cities and water agencies in the Coachella Valley recently adopted a uniform landscape ordinance which provides governance for landscape designs for new developments. The goal of the ordinances is to seek significant reductions in demands for exterior landscaping in the future and provide criteria for the reduction of turf grass for golf courses. Both the CVWD and MSWD provide technical assistance to its community for the compliance with their respective ordinances. The CVWD provides technical assistance to golf courses on irrigation system issues, checks for compliance with approved plan designs, and monitors the facilities for maximum water allowance compliance.

The Borrego Water District is also implementing a vigorous water conservation program with rebates and turf removal incentives. For IID water conservation program activities, see section on Integrated Regional Water Management.

[Placeholder: Groundwater content being developed including:

- Description of the annual groundwater use/demand by beneficial use (agricultural, municipal, and managed wetlands), and by aquifer type (alluvial versus fractured rock, if applicable),
- Discussion of groundwater use as it relates to basin priority.
- Map showing groundwater use as a percentage of the overall supply for alluvial and fractured rock aquifer (if applicable) areas, with overlay of basin prioritization.]

## Drinking Water

The region has an estimated 129 community drinking water systems. The majority (over 75 percent) of these community drinking water systems are considered small (serving less than 3,300 people) with most small water systems serving less than 500 people (see Table CR-9). Small water systems face unique

financial and operational challenges in providing safe drinking water. Given their small customer base, many small water systems cannot develop or access the technical, managerial and financial resources needed to comply with new and existing regulations. These water systems may be geographically isolated, and their staff often lack the time or expertise to make needed infrastructure repairs; install or operate treatment; or develop comprehensive source water protection plans, financial plans or asset management plans (USEPA 2012).

In contrast, medium and large water systems account for less than 25% of region's drinking water systems, however these systems deliver drinking water to over 90% of the region's population (see Table CR-9). These water systems generally have financial resources to hire staff to oversee daily operations and maintenance needs, and hire staff to plan for future infrastructure replacement and capital improvements. This helps to ensure that existing and future drinking water standards can be met.

**PLACEHOLDER Table CR-9 Summary of Large, Medium, Small, and Very Small Community Drinking Water Systems in the Colorado River Hydrologic Region**

[Any draft tables, figures, and boxes that accompany this text for the advisory committee draft are included at the end of the report.]

### **Project Operations**

[Major water supply project operations could be described here, along with challenges faced in the operations. Include a description of how reservoirs and facilities are operated to meet the varied and changing demands.]

### **Surface Water Quality**

[Describe major issues faced in the region related to surface water quality. Discuss any initiatives that have been undertaken to face these issues.]

### **Drinking Water Quality**

In general, drinking water systems in the region deliver water to their customers that meets federal and State drinking water standards. Recently, the Water Boards completed a draft statewide assessment of community water systems that rely on contaminated groundwater. This draft report identified 24 community drinking water systems in the region that rely on at least one contaminated groundwater well as a source of supply (See Table CR-10). Gross alpha particle activity, uranium, arsenic, and fluoride are the most prevalent groundwater contaminants affecting community drinking water wells in the region (see Table CR-11). The majority of the affected systems are small water systems which often need financial assistance to construct a water treatment plant or alternate solution to meet drinking water standards.

**PLACEHOLDER Table CR-10 Summary of Small, Medium, and Large Community Drinking Water Systems in the Colorado River Hydrologic Region that Rely on One or More Contaminated Groundwater Well(s)**

[Any draft tables, figures, and boxes that accompany this text for the advisory committee draft are included at the end of the report.]

## **PLACEHOLDER Table CR-11 Summary of Contaminants Affecting Community Drinking Water Systems in the Colorado River Hydrologic Region**

[Any draft tables, figures, and boxes that accompany this text for the advisory committee draft are included at the end of the report.]

### **Groundwater Quality**

[Placeholder: Groundwater content on groundwater quality being developed.]

### **Groundwater Level Trends and Issues**

[Placeholder: Groundwater content being developed including:

- Key long-term groundwater level hydrographs for the Hydrologic Region with description of seasonal and long-term groundwater level trends and aquifer response to demand during wet, normal, and dry hydrologic conditions.
- Description of estimated annual change in groundwater in storage for 2005-2010, and for each pair of consecutive years (e.g., 2005-2006, 2006-07, etc.). For Hydrologic Regions where data are not available in DWR's Water Data Library or limited, identify this as a data gap.
- Map showing location of groundwater basins and associated change contours of groundwater levels and storage, subject to availability of information.
- Chart showing trends in annual and cumulative change in groundwater in storage, subject to availability of information.
- Table containing values for annual and cumulative change in groundwater levels and storage, subject to availability of information.
- Discussion and presentation of results from other related efforts for the Hydrologic Regions to estimate change in groundwater in storage, based on availability of data and information. These efforts may include local and regional agency groundwater modeling results and results from GRACE satellite analysis.
- Discussion of the historic land subsidence for the Hydrologic Region and the potential susceptibility for the future, if pertinent to the Hydrologic Region and subject to availability of data.
- General overview of aquifer sustainability based on above data and existing groundwater management practices. More detailed trends and assessment of sustainability indicators for Hydrologic Regions for which data or modeling results are available.]

### **Flood Management**

Traditionally, the approach to flood management was to develop narrowly focused flood infrastructure projects. This infrastructure often altered or confined natural watercourses, which reduced the chance of flooding thereby minimizing damage to lives and property. This traditional approach looked at floodwaters primarily as a potential risk to be mitigated, instead of as a natural resource that could provide multiple societal benefits.

Today, water resources and flood planning involves additional demands and challenges, such as multiple regulatory processes and permits, coordination with multiple agencies and stakeholders, and increased environmental awareness. These additional complexities call for an Integrated Water Management approach, that incorporates natural hydrologic, geomorphic, and ecological processes to reduce flood risk by influencing the cause of the harm, including the probability, extent, or depth of flooding (flood hazard). Some agencies are transitioning to an IWM approach. IWM changes the implementation approach based on the understanding that water resources are an integral component for sustainable

ecosystems, economic growth, water supply reliability, public health and safety, and other interrelated elements. Additionally, IWM acknowledges that a broad range of stakeholders might have interests and perspectives that could positively influence planning outcomes.

An example of this is the Cushenbury Flood Detention Basin. The project is proposed to capture runoff from the San Bernardino Mountains in the Lucerne Valley Subbasin. Currently, large storm flows drain to dry lake beds in the area that have low percolation rates. Consequently, the majority of water that drains to the lake beds is lost to evaporation and never enters the basin. The project would divert storm flows to detention basins with high rates of percolation to decrease losses from evaporation. Flooding can deliver either environmental destruction or environmental benefits. Ecosystems can be devastated by extreme floods that wash away habitat, leaving deposits of debris and contaminants. Development in floodplains has reduced the beneficial connections between different types of habitat and adjacent floodway corridors; however, well functioning floodplains deliver a variety of benefits. Floodplains provide habitat for a significant variety of plant and wildlife species. Small, frequent flooding can recharge groundwater basins and improve water quality by filtering impurities and nutrients, processing organic wastes, and controlling erosion.

Flood management challenges in the Colorado River Hydrologic Region include:

- Flood control in the desert presenting different challenges than flooding in the rest of the state
- Outdated and undersized infrastructure
- Lack of regional perspective, real need for regional planning efforts

The identified issues were based upon interviews with six agencies with varying levels of flood management responsibilities in each county of the state. The agencies with flood management responsibility in the Colorado River Hydrologic Region that participated in the meeting include Imperial County Department of Planning and Development Services, Imperial Irrigation District, Coachella Valley Water District, and Riverside County Flood Control and Water Conservation. The agencies were asked about the status of flood management in their respective areas of responsibility.

## **Flood Hazards**

Of California's 10 hydrologic regions, the Colorado River Hydrologic Region has the lowest annual precipitation. Consequently, most of the natural streams are ephemeral; the exceptions are the Colorado, New, and Alamo rivers. The low annual rainfall amounts and the sparse vegetation in the region's watersheds give rise to braided streams with steep channel slopes. In these watercourses, short-duration, high intensity rainfall from summer monsoonal thunderstorms or winter storms can result in flash floods and debris flows. Many areas in the region are still vulnerable to flood-caused damages. Flood hazards in the region include these representative situations (for specific instances, see Challenges).

- Some existing culverts and channels do not have sufficient capacity to carry flow resulting from the runoff event having a 1 percent chance of being exceeded in any year.
- Population growth and the ensuing development increase the area of impervious surface without sufficient mitigation, increasing peak runoff.
- High intensity storms are common and combine with steep stream gradients and granular bed material to produce flash floods and debris flows.
- Alluvial fan flooding endangers some communities.
- Some locations are threatened with ponding of runoff behind seaside dikes.

## Historic Floods

Damaging floods occurred in the region in 1916 when high water in the Colorado River caused flooding at Brawley, which was repeated in 1921. In 1927, flood-stage flows in the Whitewater River washed out roads and bridges in Thousand Palms and Palm Desert. The U.S. Geological Survey estimated that the Whitewater River at White Water exceeded the 100-year flood stage in March 1938 when it isolated Palm Springs and caused several deaths.

In November of 1965 floods along the Whitewater River washed out 22 county roads. There were scour and damage to 13 miles of channel between Cathedral City and the Salton Sea. Two thousand acres of agricultural lands were flooded with erosion or silting. Citrus and date groves suffered heavy damages. Whitewater River flooding caused three fatalities and \$3 million in damages. Flooding of Tahquitz Creek washed out many roads and damaged bridge abutments on State Highway 111. Floodwaters swept 50 cars into streams and drainage channels of Tahquitz Creek and Whitewater River. Flooding of Big and Little Morongo Washes eroded roads at dip crossings, damaged homes, and swept away several cars.

In January and February of 1969 a flow of wet, tropical air from Hawaii to Southern California in January caused intense rainfall and consequent flooding in the Whitewater River basin, culminating in severe damage to roads and property in the Palm Springs area. In February, a flood struck Riverside County causing widespread inundation. Severe residential and highway damages occurred along the Whitewater River and the San Geronio River at Cabazon. Much agricultural damage was caused by flooding of the Whitewater River.

In September 1976, Tropical Storm Kathleen brought heavy rains of about 10 inches to some desert areas. San Felipe Creek overflowed and damaged 390 acres of agricultural land, irrigation works, and roads. Carrizo Wash washed out roads and rail lines. Ocotillo was flooded by Myer Creek, which left behind 1 to 3 feet of silt and mud damaging many homes and other structures. Three fatalities occurred in the Ocotillo area. Two people died on Interstate 8 when it washed out. Major flood damages occurred to Interstate 8, State Highway 98, and the San Diego and Arizona Eastern Railroad lines.

For a complete record of floods, refer California Flood Future Report Attachment C: Flood History of California Technical Memorandum.

## Damage Reduction Measures

Most flood events in the Colorado River region occur in as a result of high-intensity summer storms and take the form of flash or alluvial fan flooding. Flood exposure identifies who and what is impacted by flooding. Two flood event levels are commonly used to characterize flooding:

- 100-Year Flood is a shorthand expression for a flood that has a 1-in-100 probability of occurring in any given year. This can also be expressed as the 1 percent annual chance of, or “1 percent annual chance flood” for short.
- 500-Year Flood has a 1-in-500 (or 0.2 percent) probability of occurring in any given year.

In the Colorado River Hydrologic Region more than 227,000 people and over \$20 billion in assets are exposed to the 500-year flood event. Table CR-12 provides a snapshot of people, structures, crop value, and infrastructure, exposed to flooding in the region. Over 185 State and Federal threatened, endangered, listed, or rare plant and animal species exposed to flood hazards are distributed throughout the Colorado

River Hydrologic Region. Table CR-12 lists the number of sensitive species exposed to flood hazards in 100-year and 500-year flood events.

**PLACEHOLDER Table CR-12 Flood Exposure in the Colorado River Hydrologic Region Exposures to the 100-Year and 500-Year Flood Events**

[Any draft tables, figures, and boxes that accompany this text for the advisory committee draft are included at the end of the report.]

### **Current Relationships with Other Regions and States**

The land fallow and water supply transfer program between the Palo Verde Irrigation District and Metropolitan Water District of Southern California is being implemented smoothly. The 35-year program develops between 29.5 TAF and 118.0 TAF of water supply annually for MWDSC, helps with the stabilization of the local economy in the Palo Verde Valley, and provides financial assistance for specific local community improvement programs. In 2009, about 129 TAF of water supplies were transferred; in 2010, it was a little more than 116 TAF.

During the drought years of 2009 and 2010, these two agencies worked together to move additional Colorado River water supplies to MWDSC's service area. In calendar year, MWDSC received a little more than 32 TAF of water supplies from PVID to help mitigate the impacts of the drought.

The projects completed for the 1988 Water Conservation Agreement Between the Imperial Irrigation District and MWDSC permits the transfer of conserved water supplies to MWDSC's service area. In 2009, about 89 TAF of water supply was transferred to the MWDSC, in 2010, it was 97 TAF.

CVWD and the DWA continue to reach out to water agencies outside of the region to acquire new SWP water supplies to help with the management of the local groundwater basins. Long-term water transfer agreements were reached with the Berenda Mesa Water District and Tulare Lake Water Basin Storage District. Short-term agreements were also reached with the Rosedale-Rio Bravo Water Storage District and DMB Pacific, Inc. Additional exchange agreements between CVWD, DWA, and MWDSC were also reached that would allow for import of SWP supplies purchased during DWR's Dry Year program.

### **Implementation Activities (2009-2013)**

[This subsection contains a discussion of the actions that have been taken since the last California Water Plan update to meet the water challenges in the region.]

[Considerations for this subsection:

- The efforts we will be doing for the progress report format should provide some content for this section. We should not, however, be limited to the progress report if significant activities have occurred in the region since the last update.]

### **Drought Contingency Plans**

In their preparations of Urban Water Management Plans, most all water agencies in the Colorado River region also updated existing Water Supply Shortage Contingency Plans. These documents describe the different actions that will be undertaken to mitigate the impacts caused by either natural or man-made water supply shortages. Actions include the stages of supply shortages, actions to be taken at each stage,

programs and policies which will be implemented to decrease demands (including restrictions on certain kinds of water uses), procedures to monitor uses, and penalties for those who do not comply with specific orders. The plans also outline short-term and long-term strategies to supplement existing water supplies to lessen the impacts of shortages during real emergencies.

For over two decades, the Coachella Valley Water District and Desert Water Agency have taken the necessary steps to replenish and store water supplies in the Whitewater groundwater basin in the Coachella Valley. As reported in the Water Supply section, CVWD and DWA have entered into agreements with various agencies, including the Metropolitan Water District of Southern California, Berenda Mesa Water District and Tulare Lake Water Basin Storage District to bring additional SWP water supplies into the region for the purpose of groundwater recharge. These additional supplies would then be available to them in the event of possible future shortfalls from the SWP and Colorado River.

[Placeholder: Groundwater content being developed providing description of components of the local drought contingency plans that call for increased groundwater use via groundwater substitution water transfers or other conjunctive management practices, if pertinent to the Hydrologic Region.]

## Resource Management Strategies

[Provide a description of any initiative or action that has taken place to implement any of the more than 27 resource management strategies during the period of this California Water Plan update (2009-2013).]

[Placeholder: Groundwater content being developed including:

- Brief summary of DWR/ACWA joint survey and DWR's follow-up email and phone communications to conduct a survey to gather information on conjunctive management projects in the state.
- Description of the groundwater related conjunctive management projects for the Hydrologic Region.
- Table listing the conjunctive management projects.
- Dot Map showing location of the conjunctive management projects.
- Table showing responses on survey questions on conjunctive management projects.
- Charts showing projects by year project started, source of water, method of recharge, program goals, and potential constraints to conjunctive management, and other survey responses.
- Discussion on potential for conjunctive management in the Hydrologic Region subject to available aquifer space, source water, and infrastructure (conveyance, infiltration/injection, and extraction).
- Discussion on potential constraints to conjunctive management in the Hydrologic Region, including aquifer space, supply source, infrastructure, environmental, legal, regulatory, water quality, etc.]

## *Drinking Water Treatment & Distribution*

[Placeholder: Drinking water content under development for this section.]

## Water Governance

### *Agencies with Responsibilities*

California's water resource development has resulted in a complex, fragmented, and intertwined physical and governmental infrastructure. Although primary responsibility might be assigned to a specific local

entity, aggregate responsibilities are spread among more than 65 agencies in the Colorado River Hydrologic Region with many different governance structures. A list of agencies can be found in the California's Flood Future Report Attachment E: Information Gathering Technical Memorandum. Agency roles and responsibilities can be limited by how the agency was formed, which might include enabling legislation, a charter, a memorandum of understanding with other agencies, or facility ownership.

The Colorado River hydrologic region contains floodwater storage facilities and channel improvements funded and/or built by State and Federal agencies. Flood management agencies are responsible for operating and maintaining approximately 1,800 miles of levees, 17 dams and reservoirs and, 10 debris basins within the Colorado River Hydrologic Region. For a list of major infrastructure, refer California's Flood Future Report Attachment E: Information Gathering Technical Memorandum.

### *Flood Management Governance and Laws*

Water Code Division 5, Sections 8,000 - 9,651 has special significance to flood management activities and is summarized in California's Flood Future Report Attachment E: Information Gathering Technical Memorandum.

Recently, a number of laws regarding flood risk and land use planning were enacted in 2007. These laws establish a comprehensive approach to improving flood management by addressing system deficiencies, improving flood risk information, and encouraging links between land use planning and flood management. Two of the Assembly Bills (AB) that the California legislature passed are summarized below.

- AB 70 (2007) Flood Liability — provides that a city or county might be responsible for its reasonable share of property damage caused by a flood, if the State liability for property damage has increased due to approval of new development after January 1, 2008.
- AB 162 (2007) General Plans — requires annual review of the land use element of general plans for areas subject to flooding, as identified by FEMA or DWR floodplain mapping. The bill also requires that the safety element of general plans provide information on flood hazards. Additionally, AB 162 requires the conservation element of general plans to identify rivers, creeks, streams, flood corridors, riparian habitat, and land that might accommodate floodwater for purposes of groundwater recharge and stormwater management.

[Placeholder: Groundwater content being developed including:

- Brief description of the groundwater governance associated with the various GWMPs, IRWMPs, conjunctive management projects, groundwater recharge projects, groundwater monitoring, groundwater ordinances, and adjudicated groundwater basins within the Hydrologic Region.
- Table listing the above groundwater-related governance within the Hydrologic Region.
- Maps showing area coverage for GWMPs and IRWMPs, and “dot” locations of groundwater ordinances, adjudicated basins, and conjunctive management projects.
- Groundwater basin prioritization maps showing high, medium and low priority basins.]

### **State Funding Received**

[Describe the State funding received to implement water-related infrastructure, coordination, or planning in the region.]

## Local Investment

[Describe the local investment made to implement water-related infrastructure, coordination, or planning in the region.]

## Water Conservation Act of 2009 (SB x7-7) Implementation Status and Issues

[Provide a discussion of the status and major issues with implementation of the Water Conservation Act of 2009 for both urban and agricultural water conservation.]

## Interregional and Interstate Activities

[Describe those interregional and interstate activities that have occurred since the last California Water Plan update.]

## Looking to the Future

[Notes: (1) Although the regional forums may seek consensus on objectives for the entire hydrologic region, this section will likely be a compilation of the IRWM and other local plan objectives. (2) Reference statewide priorities or IRWM guidelines to ensure consistency. (3) Because no single resource management strategy can meet the broad set of resource management objectives, this section is meant to shift planning approach/discussions from focusing on specific types of resource management strategies (e.g., desalination vs. conservation vs. storage, etc.) to an objectives-based planning approach.]

In general, priority ecosystem improvements for the State of California, in relation to its water supply, are identified by DFG as projects that achieve one or more of the following:

- Recovery for endangered and other at-risk species and native biotic communities, including rare natural communities;
- Restore natural processes, including fluvial geomorphology and natural vegetation recruitment;
- Restore natural hydrologic processes, including magnitude, duration and timing of flows;
- Maintain or enhance populations of selected species for sustainable commercial or recreational harvest;
- Protect or restore functional habitat types including, but not limited to, floodplain, riparian, and wetland;
- prevent or reduce negative impacts from both aquatic and terrestrial non-native species including those associated with water supply and conveyance projects such as quagga and zebra mussels; and
- Improve instream flow as well as water and sediment quality conditions, including temperature, to support healthy ecosystems.
- Each of these priorities is interrelated; often accomplishments towards one goal will also provide benefits to others. DFG has identified these priority ecosystem improvements for application throughout the state.
- These priorities are not ranked, and are in no particular order. DFG cannot generally elevate the importance of one improvement type over another without information on the specific merits of the projects. However, projects that incorporate one or more of the above criteria would be viewed as valuable ecosystem improvements.

It is also important to note that many watersheds in California have completed watershed assessments, watershed management plans, and/or strategies. There are also various state conservation strategies or plans that have been completed in recent years. All of these documents identify resources within their respective project boundaries and needs for restoration, often including the potential for improving water resources via restoration or other actions. These plans should be cumulatively assessed and synthesized in relation to the California Water Plan in order to produce a document that (1) outlines common elements that address water resource issues; (2) identifies opportunities for restoration actions that will improve water resources; and (3) addresses the needs of species and/or habitats that are found and/or transcend watershed boundaries.

This list provides a list of some of the priority areas and needs specific to the Colorado River Hydrologic Region from a DFG perspective for California, in relation to California water supply.

- Acquisition of conservation easements on lands;
- Prevent or reduce negative impacts from invasive non-native species including those associated with water supply and conveyance projects such as quagga and zebra mussels, egeria densa, water hyacinth, and others;
- Restoration projects that facilitate the improvement of nesting and foraging habitat for listed and migratory bird species;
- Restoration of riparian habitat, including conservation of riparian corridors;
- Water quality improvements (sediment, oxygen saturation, pollution, and temperature) to support healthy ecosystems;
- And, restoration projects that will improve upon existing wetlands, or creates new wetlands in appropriate areas.

## **Future Conditions**

### **Future Scenarios**

[This subsection contains a discussion of the following topic. (Primary authors would be from the analytical data and tools work team.)

- Water demand by sector for future scenarios.]

[Considerations for this subsection:

- How do the three future scenarios relate to regionally derived future plans/visions? This might be the best place to examine compatibilities and contrasts of local and state objectives.
- Regional estimates regarding future agricultural, urban, and environmental water demands; economic development; flood management; land use; etc.]

### **Climate Change**

Climate change is already impacting many resource sectors in California, including public health, water, agriculture, biodiversity, and transportation and energy infrastructure (CNRA, 2009). Climate model simulations, using the Intergovernmental Panel on Climate Change's (IPCC) 21<sup>st</sup> century climate scenarios, project increasing temperatures in California, with greater increases in the summer (Cayan, 2008). Changes in annual precipitation patterns across California will result in changes to surface runoff timing, volume, and type.

While the State of California is taking aggressive action to mitigate climate change through reducing emissions from greenhouse gases (GHGs) and implementing other measures (CARB, 2008), global impacts from carbon dioxide and other GHGs that are already in the atmosphere will continue to impact climate through the rest of the century (IPCC, 2007). Resilience to an uncertain future can be achieved by implementing adaptation measures sooner rather than later. Because of the economic, geographical, and biological diversity of California, vulnerabilities and risks from current and future anticipated changes are best assessed on a regional basis. Many resources are available to assist water managers and others in evaluating their region-specific vulnerabilities and identifying appropriate adaptive actions (USEPA and DWR, 2011; Cal-EMA and CNRA, 2012a).

### *Precipitation and Extremes*

The Colorado River region is currently experiencing impacts from climate change through changes in statewide precipitation and surface runoff volumes, which in turn affect availability of local and imported water supplies. Most climate simulations used by the 2009 Climate Action Team report project drier conditions in California (CNRA, 2009). Changes in annual precipitation across California, either in timing or total amount, will result in changes to the type of precipitation (rain or snow) in a given area and to the timing and volume of surface runoff. Precipitation projections from climate models for California are not all in agreement, but most anticipate drier conditions in the southern part of California, with heavier and warmer winter precipitation in the north (Pierce, et al., 2012). Because there is less scientific detail on localized precipitation changes, there exists a need to adapt to this uncertainty at the regional level (Qian, et al., 2010).

Although annual precipitation will vary by area, reduced snow and precipitation in the Sierra Nevada range and the Colorado River basin will affect the imported water supply for the Colorado River region and cause potential overdrafting of the region's groundwater basins. Of California's ten hydrologic regions, the Colorado River region has the lowest annual precipitation (DWR, 2009). Projections for the Colorado River region indicate that the annual rainfall will decrease in the more urbanized areas, with the southern Imperial Valley getting about 0.5 inches (1.3 cm) of less rain and the more eastern desert areas seeing little change (Cal-EMA and CNRA, 2012b).

On the other hand, extremes in California's precipitation are projected to increase with climate change (Dettinger, 2012). Recent computer downscaling techniques indicate that California flood risks from warm-wet, atmospheric river type storms may increase beyond those that we have known historically, mostly in the form of occasional more-extreme-than-historical storm seasons (Dettinger, 2011). Winter runoff could result in flashier flood hazards. Higher flow volumes will scour stream and flood control channels, degrading habitats already impacted by shifts in climate and placing additional stress on special-status species. The lower deserts of the Colorado River region are susceptible to flooding, which is a concern in the Borrego and Coachella Valleys. The Whitewater River has caused severe flooding back in 1965, 1969, and 1976 (DWR, 2009). The occasional summer monsoonal thunderstorms that the lower deserts experience could increase in frequency and intensity and result in flash floods and debris flows, especially in areas with alluvial fans.

### *Water Supply and Snowpack*

During the last century, the average early snowpack in the Sierra Nevada decreased by about ten percent, which equates to a loss of 1.5 million acre-feet of snowpack storage (DWR, 2008). The Sierra Nevada snowpack, which is an important source of water for parts of the Colorado River region through the SWP,

is expected to continue to decline as warmer temperatures raise the elevation of snow levels, reduce spring snowmelt, and increase winter runoff. DWR projects that the Sierra Nevada will experience a 25 to 40 percent reduction of snowpack from its historic average by 2050 (DWR, 2008). In addition, earlier seasonal flows will reduce the flexibility in how the state manages its reservoirs to protect communities from flooding while ensuring a reliable water supply.

Water supplies coming from the Colorado River Basin outside California are also decreasing (CNRA, 2009). Similar climate effects, although much more variable, are anticipated for the Rocky Mountains snowpack that supplies the Colorado River, another important source of water for the Colorado River region (Christensen, et al., 2004; Mote, et al., 2005; Williamson, et al., 2008; Guido, 2008). Even though variability exists in the snowpack levels of the Rocky Mountains, streamflows in the Colorado River appear to be peaking earlier in the year (Stewart, et al., 2005), and the average water yield of the Colorado River could be reduced by 10 to 20 percent due to climate change (USBR, 2011).

Sea level rise, although not a direct impact to the Colorado River region, is expected to degrade the quality of the region's imported water from the Delta, as well as increase salinity intrusion and impact the Delta levee infrastructure, requiring substantial capital investments by the public. According to the California Climate Change Center, sea level rose 7 inches (18 cm) along California's coast during the past century (DWR, 2008; CNRA 2009).

### *Water Demand*

Water supplies within California are already stressed because of current demand and expected population growth. Even though the Colorado River region represents about two percent of the State's population, it grew by 18 percent between 2000 and 2005 (DWR, 2009). The uncertainty on the extent of these environmental changes will no doubt reduce the ability of local agencies to meet the water demand for the Colorado River region, if these agencies are not adequately prepared.

Changes in climate and runoff patterns may create competition among sectors that utilize water. The agricultural demand within the region could increase due to higher evapotranspiration rates caused by increased temperatures. Prolonged drought and decreased water quality could further diminish the viability of intermittent streams characteristic of this region and the Salton Sea, the state's largest lake. The Salton Sea is a critical stop for migratory birds on the Pacific and Central Flyways, and, as the lake's level declines and sediments currently underwater get exposed, birds and fish would be impacted and increased amounts of windborne dust could affect human health in the Coachella and Imperial Valleys, as well as in Mexico (USGS, 2007).

Environmental water supplies would need to be retained for managing flows in habitats for aquatic and migratory species throughout the dry season not only for the Salton Sea, but also for the region's imported source water. Currently, Delta pumping restrictions are in place to protect endangered aquatic species. Climate change is likely to further constrain the management of these endangered species and the state's ability to provide water for other uses. For the Colorado River region, this would further reduce supplies available for import through the SWP during the non-winter months (Cayan, 2008; Hayhoe, 2004). The U.S. Bureau of Reclamation's (USBR) Lower Colorado Region, which serves as the water master for the lower Colorado River, must also balance water supply with demand, including water-dependent ecological systems and habitats, hydroelectric generation, water quality, and recreation (USBR, 2011).

### *Temperatures, Droughts, Wildfires, and Floods*

Temperature projections are in wide agreement on a warming trend statewide. California's temperature already has risen by 1 °F (0.6 °C), mostly at night and during the winter, with higher elevations experiencing the highest increase (DWR, 2008). Regionally-specific temperature data can be retrieved through the Western Regional Climate Center (WRCC)\*. Locally in the Colorado River region within the WRCC Sonoran Desert climate region, mean temperatures have increased by about 0.9 to 2.0 °F (0.5 to 1.1 °C) in the past century, with minimum and maximum temperatures increasing by about 1.6 to 2.7 °F (0.9 to 1.5 °C) and by 0.2 to 1.5 °F (0.1 to 0.8 °C), respectively (WRCC, 2012). Within the WRCC Mohave Desert climate region, mean temperatures have increased by about 1.2 to 2.4 °F (0.7 to 1.3 °C) in the past century, with minimum and maximum temperatures increasing by about 1.5 to 2.6 °F (0.8 to 1.4 °C) and by 0.9 to 2.3 °F (0.5 to 1.3 °C), respectively (WRCC, 2012).

By 2050, mean temperatures are projected to increase in the Colorado River region by 2 to 4 °F (1.1 to 2.2 °C) during winter and by 3 to 5 °F (1.7 to 2.8 °C) during summer (Cal-EMA and CNRA, 2012b). By the end of this century in 2100, mean temperatures are projected to increase about 5 to 8 °F (2.8 to 4.4 °C) during winter and up to 6 to 9 °F (3.3 to 5.0 °C) during summer (Cal-EMA and CNRA, 2012b). Pierce, et al. (2012) offer a more sophisticated modeling study, which projects that by 2070 the annual mean temperature will increase by °F (2.6 °C) for the WRCC Sonoran Desert climate region, with increases of °F (2.0 °C) during the winter months and °F (3.0 °C) during summer. The WRCC Mohave Desert climate region has similar projections with annual mean temperatures increasing by 4.9 °F (2.7 °C), winter temperatures increasing by 3.6 °F (2.0 °C), and summer temperatures increasing by 5.9 °F (3.3 °C) (Pierce, et al., 2012).

Prolonged drought events are likely to continue and further impact the availability of local and imported surface water and contribute to the depletion of groundwater supplies. With increasing temperatures, net evaporation from reservoirs is projected to increase by 15 to 37 percent (Medellin-Azuara, et al., 2009; CNRA, 2009). Although the existing storage capacity for the Colorado River has provided the ability to meet water demands during sustained droughts, droughts of greater severity have occurred and will likely occur again in the future (USBR, 2011).

Higher temperatures and decreased moisture during the summer and fall seasons, particularly in the mountain reaches of the lowland desert area, will increase vulnerability to wildfire hazards in the Colorado River region and impact local watersheds, though the extent to which climate change will alter existing risk to wildfires is variable (Westerling and Bryant, 2006). Little change is projected for most of the region, except for the Mecca San Geronio and San Jacinto Mountains, which are likely to have 1.5 to 2 times more wildfires (Cal-EMA and CNRA, 2012b). However, early snowmelt and drier conditions will increase the size and intensity of these fires (Westerling, 2012).

Furthermore, wildfires can contribute to debris flow flooding in vulnerable communities in the foothills of the Colorado River region. In 2003, the community of Borrego Springs was flooded by storm water runoff flowing from the Ranchita area that had earlier been scorched by fire (DWR, 2009). The highly unpredictable nature of alluvial fans within a region can create flooding situations dependent on rain, vegetation, and wildfires (Stuart, 2012).

A recent study that explores future climate change and flood risk in the Sierras, using downscaled simulations (refining computer projections to a scale smaller than global models) from three global

climate models (GCMs) under an accelerating GHG emissions scenario that is more reflective of current trends, indicates a tendency toward increased three-day flood magnitude. By the end of the 21st century, all three projections yield larger floods for both the moderate elevation northern Sierra Nevada watershed and for the high elevation southern Sierra Nevada watershed, even for GCM simulations with 8 to 15 percent declines in overall precipitation. The increases in flood magnitude are statistically significant for all three GCMs for the period 2051 to 2099. By the end of the 21st Century, the magnitudes of the largest floods increase to 110 to 150 percent of historical magnitudes. These increases appear to derive jointly from increases in heavy precipitation amount, storm frequencies, and days with more precipitation falling as rain and less as snow. The frequency of floods by the end of this century increased for two of the models, but remained constant or declined for the third model. (Das, et al., 2011.)

Even though this study focused on the Sierras, these scenarios could potentially be indicative of other regional settings already experiencing flooding risks. Therefore, it is essential for local agencies to take action and be ready to adapt to climate change to protect the well-being of local communities.

### *Adaptation*

As the science of climate change quickly develops and evolves, local, state, and federal agencies face the challenge of interpreting new information and determining which methods and approaches are appropriate for their planning needs. The *Climate Change Handbook for Regional Water Planning* provides an analytical framework for incorporating climate change impacts into a regional and watershed planning process and considers adaptation to climate change (USEPA and DWR, 2011). This handbook provides guidance for assessing the vulnerabilities of California's watersheds and regions to climate change impacts, and prioritizing these vulnerabilities.

### *Tools, Resources, and Collaboration*

In addition to the handbook mentioned above, the State of California has developed additional on-line tools and resources to assist water managers, land use planners, and local agencies in adapting to climate change. These tools and resources can be found under Additional References.:

The myriad of resources and choices available to managers can seem overwhelming, and the need to take action given uncertain future conditions is daunting. There are many low-regret actions that water managers in the Colorado River region can take to prepare for climate change, regardless of the magnitude of future warming. These low-regret actions involve adaptation options where moderate levels of investment increase the capacity to cope with future climate risks (The World Bank, 2012).

Water managers and others will need to consider both the natural and built environments as they plan for the future. Stewardship of natural areas and protection of biodiversity are critical for maintaining ecosystem services important for human society, such as flood management, carbon sequestration, pollution remediation, and recreation. Land use decisions are central components in preparing for and minimizing the impacts from climate change (CNRA, 2009). Increased cross-sector collaboration among water managers, land use planners and ecosystem managers provides opportunities for identifying common goals and actions needed to achieve resilience to climate change and other stressors. Strategies to manage local water supplies must be developed with the input of multiple stakeholders (Jackson, et al., 2012). While both adaptation and mitigation are needed to manage risks and are often complementary and overlapping, there may be unintended consequences if efforts are not coordinated (CNRA, 2009).

The Imperial Valley Regional Water Management Group (RWMG) recognizes the disconnect between land use planning and water supply within its area and has brought land use representatives from Imperial County, local cities, and unincorporated towns into its IRWM membership to assist with updating its IRWM plans and prioritizing its projects. A mitigation policy for cumulative impact of development within the region is one of the priorities for the Imperial Valley RWMG. Another example of integrating across sectors is a tool developed by the California State University at San Bernardino – Water Resources Institute developed in partnership with DWR, which is a web-based portal for land use planning in alluvial fans and uses an integrated approach in assessing hazards and resources (<http://aftf.csusb.edu/>; Lien-Longville, 2012).

### *Strategies*

Adaptation strategies to consider for managing water in a changing climate include developing coordinated plans for mitigating future flood, landslide, and related impacts, implementing activities to minimize and avoid development in flood hazard areas, restoring existing flood control and riparian and stream corridors, implementing tiered pricing to reduce water consumption and demand, increasing regional natural water storage systems, and encouraging low impact development to reduce storm water flows, and promoting economic diversity and supporting alternative irrigation techniques within the agriculture industry. To further safeguard water supplies, other promising strategies include adopting more water-efficient cropping systems, investing in water saving technologies, and developing conjunctive use strategies. In addition, tracking forest health in the mountain areas and reducing accumulated fuel load will provide a more resilient watershed ecosystem that can mitigate for floods and droughts. (DWR, 2008; Hanak and Lund, 2011; Cal-EMA and CNRA, 2012c; CNRA, 2012; Jackson, et al., 2012.)

There are several Resource Management Strategies found in Volume 3 of the California Water Plan Update 2013 that not only assist in meeting water management objectives but also provide benefits for adapting to climate change, including the following:

- Agricultural and Urban Water Use Efficiency
- Water Transfers
- Conjunctive Management and Groundwater Storage
- Desalination (Ch. 9); Recycled Municipal Water
- Surface Storage – Regional/Local
- Drinking Water Treatment and Distribution
- Groundwater/Aquifer Remediation
- Pollution Prevention
- Salt and Salinity Management
- Agricultural Land Stewardship
- Economic Incentives
- Ecosystem Restoration
- Forest Management
- Land Use Planning and Management
- Recharge Area Protection
- Watershed Management
- Integrated Flood Management

### *Local Actions*

Already RWMGs in the Colorado River region are taking action. The Mojave RWMG is implementing projects that assist in adapting to climate change. The Mojave RWMG has facilitated water conservation projects and has received funding to complete a recharge project in the Joshua Basin. The Coachella Valley RWMG is including integrated flood management and a ground water monitoring strategy into its IRWM plan update and has received implementation funds to treat arsenic in the water supply of disadvantaged communities. Priorities for the Imperial Valley RWMG include protecting its sole-source aquifer in the Ocotillo area and managing groundwater to include desalination and storage.

Central to adaptation in water management is full implementation of IRWM plans that address regionally appropriate practices that incorporate climate change adaptation. These IRWM plans, along with regional flood management plans, can integrate water management activities that connect corridors and restore native aquatic and terrestrial habitats to support the increase in biodiversity and resilience for adapting to changes in climate (CNRA, 2009). However, with limited funds the RWMGs must prioritize its investments.

Additional work is underway to better understand impacts of climate change and other stressors on water supply and demand for the Colorado River region. USBR is conducting a basin study to define current and future imbalances in water supply and demand in the Colorado River Basin and the adjacent areas of the Basin States, including California, that receive Colorado River water (USBR, 2011). Through this study, USBR will develop and analyze adaptation and mitigation strategies to resolve those imbalances.

DWR is assisting the Anza-Borrego RWMG by documenting the past, present, and range of foreseeable future conditions within the local groundwater basins of the Borrego Valley and summarizing the information in an *Anza-Borrego Desert Region Summary* report. USBR also is collaborating with the Borrego Water District and other local water agencies in a basin study specific to California's Colorado River region to assess the effects of prolonged drought, population growth, and climate change, and to develop adaptation strategies for the region to handle future water supply and water quality demands (USBR, 2010).

The Salton Sea Species Conservation Habitat Project completed a Draft Environmental Impact Statement/Environmental Impact Report that discussed climate change impacts and provided an analysis of GHG emissions (USACE and CNRA, 2011), and the Cities of Palm Desert and Palm Springs have conducted GHG emissions inventories and adopted GHG targets (DeShazo and Matute, 2012). According to the Luskin Center for Innovation report, roughly one third of southern California cities have taken steps towards reducing GHG emissions (DeShazo and Matute, 2012), but more work still needs to be done, not only in mitigating for but also in adapting to climate change.

### *Planning Approaches*

The Colorado River region contains a diverse landscape with different climate zones, making it difficult to find one-size-fits-all adaptation strategies. Water managers and local agencies must work together to determine the appropriate planning approach for their operations and communities. While climate change adds another layer of uncertainty to water planning, it does not fundamentally alter the way water managers already address uncertainty (USEPA and DWR, 2011). However, stationarity (the concept that natural systems fluctuate within an unchanging envelope of variability) can no longer be assumed, so new approaches will likely be required (Milly, et al., 2008). Whatever approach is used, it is necessary for

water managers and communities to start implementing adaptation measures sooner than later in order to be prepared for an uncertain future.

IRWM planning is a framework that allows water managers to address climate change on a smaller, more regional scale. Climate change is now a required component of all IRWM plans. IRWM regions must identify and prioritize their specific vulnerabilities, and identify adaptation strategies that are most appropriate for sub-regions. Planning strategies to address vulnerabilities and adaptation to climate change should be both proactive and adaptive, starting with low-regret strategies that benefit the region in the present-day, while adding future flexibility and resilience under uncertainty.

### *Mitigation*

There is a need to mitigate for climate change by reducing the GHG emissions related to water usage, and comparing energy intensity of various water supplies when making portfolio choices. While both adaptation and mitigation are needed to manage risks and are often complementary and overlapping, there may be unintended consequences if efforts are not coordinated (CNRA, 2009).

This is the first California Water Plan to include specific energy intensity information related to water. When making water management choices, water managers can include the energy intensity of individual supplies as part of the decision making process. Figure CR-2 indicates relative energy intensity of raw water extraction and conveyance for the primary water supply sources for this region (caption and footnotes under development). It provides a tool to assist decision making in water management regarding water and energy efficiency and to help evaluate what type of water supply portfolio is used to meet demand within the hydrologic region.

In addition, many water use efficiency and other best management practices can also mitigate climate change (see Volume 2, Resource Management Strategies).

### **PLACEHOLDER Figure CR-2 Energy Intensity**

[Any draft tables, figures, and boxes that accompany this text for the advisory committee draft are included at the end of the report.]

\*The WRCC has temperature and precipitation data for the past century. Through an analysis of National Weather Service Cooperative Station and PRISM Climate Group gridded data, scientists from the WRCC have identified 11 distinct regions across the state for which stations located within a region vary with one another in a similar fashion. These 11 climate regions are used when describing climate trends within the state (Abatzoglou, et al., 2009). DWR's hydrologic regions, however, do not correspond directly to WRCC's climate regions. A particular hydrologic may overlap more than one climate region and, hence, have different climate trends in different areas. For the purpose of this regional report, climate trends of the major overlapping climate regions are considered to be relevant trends for respective portions of the overlapping hydrologic region.

### **Interregional and Interstate Planning Activities**

[This subsection contains a discussion of the following topics.]

- A summary of relevant planning or implementation activities that will affect this region.
- Regional stake in process.

- Strategies for regional self-sufficiency: Define goals and purpose of self-sufficiency.]

[Considerations for this subsection:

- Consider listing Update 2009 objectives to reflect statewide objectives/vision:
  - Reduce Water Demand.
  - Improve Operational Efficiency and Transfers.
  - Increase Water Supply.
  - Improve Water Quality.
  - Practice Resource Stewardship.
  - Improve Flood Management.]

[Placeholder: Groundwater content being developed to include description of interregional and interstate water resource planning activities that have identified increase use of groundwater in their planning (interstate examples include Klamath Basin for the North Coast Hydrologic Region, and the Honey Lake Basin for the North Lahontan Hydrologic Region).]

## **Flood Risk Characterization**

Geology and climate shape the topography of the Colorado River Hydrologic Region. Numerous faults exist, including the San Andreas Fault, and they are responsible for the mountainous terrain in the north and the large valleys and plains in the south. The northern third of the hydrologic region is part of the Mojave Desert and features small to moderate mountain ranges, dormant volcanoes, cinder cones, hills, and narrow U-shaped valleys. The remainder of the hydrologic region is part of the Sonoran Desert, is less mountainous, and is dominated by the Salton Sea and the Imperial, Coachella, and Palo Verde valleys.

Major rivers in the hydrologic region are the Colorado, Alamo, New, and Whitewater. Most other rivers, streams, and washes, such as Piute Wash and San Felipe Creek, are intermittent or normally dry. The Colorado River system terminates in Mexico at the Gulf of California. All other streams in the hydrologic region having significance to flood management terminate in the Salton Sea except Quail Wash, which ends at Coyote Lake.

Floods can be caused by heavy rainfall; by dams, levees, or other engineered structures failing; or by extreme wet-weather patterns. Flooding from snowmelt typically occurs in the spring and has a lengthy runoff period. Flooding from rainfall occurs in the winter and early spring, particularly when storms arriving from the Gulf of Alaska draw moisture-laden air from the tropics. This pattern is known as an Atmospheric River. Extreme events occur when an atmospheric river event occurs in the early spring causing snow to melt, exacerbating runoff from the rainfall.

### ***Levee Performance and Risk Studies***

Flood hazard mitigation planning is an important part of emergency management planning for floods and other disasters. Hazard mitigation is defined as any sustained action taken to reduce or eliminate long-term risk to human life and property from hazards. Hazard mitigation planning is the process through which natural hazards that threaten communities are identified, likely impacts of those hazards are determined, mitigation goals are set, and appropriate strategies that would lessen the impacts are determined, prioritized, and implemented. Hazard mitigation planning is required for state and local governments to maintain their eligibility for certain Federal disaster assistance and hazard mitigation funding programs.

Multi-Hazard Mitigation Plans (MHMPs) are required by FEMA as a condition of pre- and post-disaster assistance. The Stafford Act, as amended by the Disaster Mitigation Act of 2000, provides for states, tribes, and local governments to undertake a risk-based approach to reducing risks to natural hazards, such as flooding, through mitigation planning. The National Flood Insurance Act reinforced the need and requirement for mitigation plans linking flood mitigation assistance programs to state, tribal and local mitigation plans. FEMA-approved MHMPs were identified or collected for Riverside and San Bernardino Counties. Other risk assessment studies were prepared by various entities including USACE, FEMA, and the State Reclamation Board of California. For a complete list of studies, refer to California's Flood Future Report Attachment G: Risk Information Inventory Technical Memorandum.

In the Colorado River Hydrologic Region twenty-five local flood management projects or planned improvements are identified in the Colorado River Hydrologic Region. Twenty-two of those projects have costs totaling more than \$107 while the remaining projects do not have costs associated with them at this time. Two local planned projects that implement an Integrated Water Management (IWM) approach to flood management, the Cushenbury Flood Detention Basin and the San Jacinto River Gap Project. For a complete list of projects, refer to California's Flood Future Report Attachment G: Risk Information Inventory Technical Memorandum.

## **Future Vision**

### **Regional Future Vision**

[This subsection would describe the desired future condition that the local stakeholders have for this region. Concepts such as regional water self-sufficiency, flood protection from a 100-year flood, conservation goals, and land use goals could be described here.]

### **Tribal Objectives/Vision**

[Objectives and vision of the tribal interests in the region would be described here.]

### **Relevant Statewide Interests and Objectives**

[Describe statewide interests and objectives and how they might influence or affect the region. State government initiatives would be discussed in relation to the region.]

## **Regional Water Planning and Management**

The Colorado River Hydrologic Region's two main outside water resources, Northern California and the Colorado River, are of concern. The Coachella Valley's share of SWP water from Northern California is being temporarily reduced by up to one-third after a 2008 federal court ruling affecting 25 million Californians. Simultaneously, the worst drought in 500 years has reduced flows on the Colorado River to about half of normal, and storage in Lake Mead and Lake Powell are also at about 50 percent.

Years after desert farmers reduced their water use, CVWD is building the \$70 million Mid-Valley Pipeline. The pipeline will provide about 50 of the valley's 124 golf courses with Colorado River water for irrigation, leaving higher-quality aquifer water for drinking use. Another \$40 million project to build a new groundwater recharge facility south of La Quinta will use Colorado River water to replenish the east valley portion of the underground aquifer.

## **Integrated Regional Water Management Coordination and Planning**

[Placeholder: Groundwater content being developed to provide summary of the GWMPs for the Hydrologic Region with brief description of overlap, management gaps, and degree of coordination.]

Flood management in the future will require unprecedented integration among traditionally varying agencies that have overlapping and sometimes conflicting goals and objectives. More reliable funding and improved agency alignment are required at all levels. Updated technical and risk management approaches will be needed to protect the public from flooding by assessing risk, as well as by improving flood readiness, making prudent land use decisions, and promoting flood awareness. Project implementation methods could benefit from IWM-based approaches to leverage the limited funding and other flood management resources. In short, future solutions should be aligned with broader watershed-wide goals and objectives and must be crafted in the context of IWM

Integrated Regional Water Management (IRWM) promotes the coordinated development and management of water, land, and related resources to maximize the resultant economic and social welfare in an equitable manner without compromising the sustainability of vital ecosystems. Flood management is a key component of an integrated water management strategy.

Four Integrated Regional Water Management regions have been formed for the Colorado River Hydrologic Region. They are identified as the Anza-Borrego Desert, Coachella Valley, Imperial and the southern portion of Mojave Desert. Presently, the members of each group are either in the process of developing a suitable IRWM Plan for their area or updating an existing Plan to meet current standards. IRWM members and stakeholders have reached out to a wide range of interest groups for assistance with the development of strategies to resolve present-day and future water management challenges in the region. The Colorado River region has several disadvantaged communities and the IRWM groups are involving them in the planning process. Interest has grown for the IRWM activities as local agencies have come to recognize that regional integration can enhance their collective power and ability to manage the region's water resources in a sustainable way.

As a result of IRWM planning efforts, local agencies and stakeholders in the region have developed an array of projects and programs to meet their water management objectives. The array includes projects that will sustain existing and future surface water and groundwater supplies and protects the environment. The region is now poised to begin implementation of projects that have been developed through the planning process including recycled water expansion, desalters, pipeline interconnection, habitat restoration and invasive species control, stormwater capture and reuse, and water use efficiency programs. Important projects include City of Imperial's Keystone Water Reclamation Facility; the IWA Recycled Water Program which promotes groundwater recharge (replenishment) and increased reliability; the Smart Water Conservation Programs (a project that utilizes a variety of education and outreach methods to increase water conservation throughout the Coachella Valley); East Brawley Groundwater Desalination Project, and the East Wide Channel, Long Canyon and Tributaries Master Plan project (improve current detention dams, levees and reservoirs near the mouths of Long Canyon and West Wide Canyon make stormwater collection/capture more efficient and flood waters more manageable in Coachella Valley).

Other examples of IRWM planning and implementation activities include the Mojave IRWM group facilitating water conservation programs and, with the funding aid, complete a recharge project in the Joshua Basin. The Coachella Valley RWMG is including integrated flood management and a ground

water monitoring strategy into its IRWM plan update and has received implementation funds to treat arsenic in the water supply of disadvantaged communities. Priorities for the Imperial Valley RWMG include protecting its sole-source aquifer in the Ocotillo area and managing groundwater to include desalination and storage.

## Accomplishments

In the Colorado River Hydrologic Region, a number of flood risk management recommendations were accomplished as described below:

- DWR has created a climate change handbook to help local agencies incorporate climate change into planning activities. In addition, the State of California has developed a statewide climate change adaptation strategy, requested that the National Academy of Science establish an expert panel to report on impacts of sea level rise, and issued interim guidance to agencies on planning for sea level rise in designated coastal and floodplain areas.
- DWR has collaborated with the USACE to produce *California's Flood Future: Recommendations for Managing the State's Flood Risk*, which will help guide local, State, and Federal decisions about policies and financial investments related to improved public safety and flood management throughout California. Information for the California's Flood Future Report was provided by 142 public agencies located in all 58 counties, as well as by State and Federal agencies.
- IRWM planning guidelines were revised to incorporate flood management into the process giving credit for including these flood benefits in Integrated Water Management projects.
- Comments and recommendations from the Flood Risk Management Strategy in the 2009 California Water Plan were used to inform:
  - SFMP California's Flood Future Report
  - IRWM planning

Water Code Section 8307 links flood liability with local planning decisions. Cities and counties now share flood litigation liability with the State over unreasonably approved new development on previously undeveloped areas

[Placeholder: Groundwater content being developed including:

- Discussion of the GWMPs within the Hydrologic Region that are SB 1938 compliant. Highlight key aspects of effective groundwater management and conjunctive management efforts in these areas.
- Map showing high priority basins in the Hydrologic Region that are covered with SB 1938 compliant GWMPs.
- Case Studies: a) in groundwater management accomplishments/challenges associated with various groundwater aquifer conditions (declining aquifer, coastal aquifer, poor water quality aquifer, fractured rock aquifer, etc.); b) that illustrate potential and challenges associated with resources management strategies such as conjunctive management and groundwater storage; and c) that illustrate successes and challenges associated with implementation of groundwater legislation.]

## **Accomplishments**

### *Environmental Mitigation Projects*

Although the All-American and Coachella Canal lining projects were completed several years ago, environmental mitigation projects associated with both are currently underway. For the Coachella Canal project, seven important mitigation projects and related activities were identified. (1/) Some of the projects have been completed and includes the Dos Palmas Water Supply System. This conveyance facility transports diverted water supplies from the Coachella Canal to specific locations for the recharge of groundwater in confined and unconfined aquifers and for the irrigation of marsh and aquatic vegetation in the Dos Palmas Conservation Area on the east-northeast shoreline area of the Salton Sea. Two important projects are occurring in the Dos Palmas area. The first requires the maintenance of the existing Core Marsh\aquatic habitat and monitoring of bird species including the Yuma Clapper Rail. The second project involves the restoration of the native habitat (about 352 acres). This second phase began in 2008 and has Dos Palmas area is another mitigation project. It began in 2008 and after the clearing of salt cedar plants is complete, will involve the planting of other desert riparian species including wolf berry, honey mesquite, ironwood, and palo verde.

### **Water Transfer**

In 2003, IID implemented a land fallowing program within its service area to generate water to fulfill the SDCWA water transfer and the Salton Sea mitigation delivery schedules. In 2006-2007, 169 fields (17,984.4 acres) were fallowed, which yielded just over 96 thousand acre-feet. For 2006-2007, 150 fields (16,172 acres) were fallowed, which yielded over 89 thousand acre-feet.

For the Federal Quantification Settlement Agreement, the IID implemented a land fallowing program to generate water supplies to fulfill the SDCWA water transfer and the Salton Sea mitigation delivery schedules. For fiscal year 2010-2011, about 9,330 acres of land was fallowed and the yield (at the farm gate) was 50,266 AF. In fiscal year 2011-2012, 5,796 acres were fallowed and the yield was 30,134 AF.

### *Lower Colorado River Multi-Species Conservation Program*

Progress is being made to implement the \$26 million LCR-MSCP. The program activities are separated into nine different categories, which include fish augmentation, species research, and system monitoring. Work has been initiated on a number of programs including those involving system monitoring and conservation area development and management. New habitat was created of the Pelo Verde Ecological Preserve.

### *Imperial Irrigation District System Conservation Plan*

Work is underway on an ambitious project by the IID to increase the operational efficiency of its water conveyance system. The project is called the “System Conservation Plan” and will address five key system upgrades. They are: (1) upgrades to the existing supervisory control and data acquisition system, (2) construction of mid-lateral reservoirs, (3) construction of lateral interties, (4) construction of the mid-valley collector system, and (5) installation of non-leak gates. The lateral interties would collect operational spills occurring in one lateral and transport them to other laterals or canals in the areas. The project will also improve gate measurement procedures. Seventeen separate tasks have been identified in the project.

This is in response to the IID study entitled “Efficiency Conservation Definite Plan that was released in 2007. The study identified on-farm programs, delivery system improvements, and financial incentives that would yield conserved water supplies for transfer under the Federal Quantification Settlement Agreement.

### **Groundwater Storage**

Greater cooperation is occurring between water agencies within and outside of the Coachella Valley to address the overdraft of the local groundwater basin. Programs described in Bulletin 160-2009 are continuing to be implemented. They include the advanced storage agreement between CVWD, DWA, and MWDSC regarding Colorado River supplies and the 75 year project between CVWD and IID that would permit the latter agency to store a portion of its Colorado River supplies in the Whitewater Groundwater Basin. This is in addition to long- and short-term transfers of SWP water supplies between CVWD and DWA and water agencies in the San Joaquin Valley.

For the upper or northern portion of the Whitewater Groundwater Basin, the SWP supplies received through the exchange program are released into the Whitewater River channel which eventually percolates and recharges the basin. In the lower or southern portion of the basin, CVWD operates the Thomas E. Levy Groundwater Replenishment Facility which is located near Lake Cahuilla and recently activated the Martinez Canyon Pilot Recharge Facility in the same part of the Coachella Valley. Colorado River water supplies are used for the recharge operations at these facilities. About 32,250 AF was recharged at the Thomas e. Levy facility.

Water recycling continues to expand in the region. CVWD is currently operating six wastewater treatment plants. Flows from three of the facilities are used to irrigate greenbelts and golf courses, while some of the supplies are used to recharge groundwater. In 2010, total recycled water use was about 16 thousand acre-feet. The district projects recycled water use to increase to slightly below 30 thousand acre-feet per year by 2030.

### **Urban Water Conservation**

CVWD has updated and approved a revised landscape ordinance for customers within its service area. With this update, the CVWD hopes to decrease overall water use, eliminate the runoff of irrigation water into the streets, and limit turf grass allowance for golf courses.

The Twentynine Palms Water District has been implementing very aggressive water audit, leak detection, and water main replacement programs for the past decade. The agency conducts a very efficient preventive maintenance program and detects and repairs leaks in its distribution system quickly. Annual unaccounted water losses have been reduced by over 90 percent.

### **Water and Wastewater Treatment**

For several years, the City of Blythe has been able to treat and deliver potable water supplies to its residential and commercial customers with its new water treatment facility. Completed in 2007, the facility has two 1,500 gpm wells, new filtration equipment, and reservoir storage. The new wells has allowed the City to terminate other wells in its service area which have had problems with bacterial contamination and groundwater pollution problems.

Design activities are nearing completion for the City of Imperial's Keystone Regional Water Reclamation Facility. The facility will provide wastewater treatment for urban residents and businesses in an area which includes the City of Imperial, southern portion of the City of Brawley, and the Imperial Community College. It will be able treat wastewater flows up to 5 MGD and produce Table 22 recycled water supplies. Potential users of the recycled water have been identified.

### *New River*

In addition to the establishment of the three wetland sites, discussions are moving ahead for the development and finalization of a strategic plan for the New River that would identify specific actions to address public health concerns and help meet environmental and water quality benchmarks for the Salton Sea. The plan is a part of the New River Improvement Project and is being developed under the guidance of the City of Calexico and the California-Mexico Border Relations Council under the authority granted by AB 1079 (Perez, 2009). Cal EPA is also technical support. A framework for a plan was released in July 2012. Possible actions which could be taken include the installation of screens to collect the large items and trash floating in the river and the construction of a treatment plant for the removal of contaminants and raw sewage in the water. The actions in this proposed strategic plan would be performed in conjunction with activities currently underway. This would include the partial treatment of the water in the New River in Mexico before it flows into the United States, the voluntary TMDL compliance program being implemented by the farmers in the Imperial Valley, and the Drain Water Improvement Program by the Imperial Irrigation District.

This is not the sole activity concentrating on the New River. The U. S. Environmental Protection Agency will also examine the problems of the New River as part of its Border 2020 Plan. A citizens' action group, the Calexico New River Committee, also released a report with its recommendations to mitigate the problems.

### **Solar Power Plants**

Due to its favorable climate, planning and installation activities continue for new solar power plants in the Colorado River region. The expansion is in response to State energy policies which require electric utilities to use power from renewable resources for 33 percent of its power by 2020. Both the United States Bureau of Land Management and California Energy Commission are playing important roles in the planning and construction process. These facilities will use groundwater supplies, however, the annual water demands are expected to be small. Construction is underway for some of the facilities. These include the Desert Sunlight Solar Farm and Genesis Solar Project; both of which are near the City of Blythe. In the NEPA\CEQA process are the McCoy Solar Energy Project (near the City of Blythe), Desert Harvest Solar Project (near the community of Desert Center, Riverside County), Ocotillo Sol Project (Imperial Valley), and the Chevron Lucerne Valley Solar Project (Lucerne Valley, San Bernardino County).

### **Flood Control**

Major flood control accomplishments in the Colorado River Hydrologic Region since 2000 include:

- Imperial County Multi-Hazard Mitigation Plan, in progress
- Multi-Jurisdictional Hazard Mitigation Plan, San Diego County, California, adopted in 2004

- Riverside County Operational Area Multi-Jurisdictional Local Hazard Mitigation Plan, approved in 2005
- San Bernardino Operational Area, Multi-Jurisdictional Hazard Mitigation Plan, approved in 2005.

## Challenges

[Note: Drinking water content under development for this section.]

Threatened or endangered fish species on the main stem of the Colorado River include the Colorado pikeminnow, razorback sucker, humpback chub, and bonytail chub. Efforts to protect these fish may impact reservoir operations and streamflow in the main stem and tributaries, which are critically important to California's ability to store and divert Colorado River water supplies. Other species of concern in the basin include the bald eagle, Yuma clapper rail, black rail, southwestern willow flycatcher, yellow warbler, vermilion flycatcher, yellow-billed cuckoo, and Kanab ambersnail.

The region faces challenges in intra-regional planning and management including how to better integrate land use and water plans and resolve conflicts within the region related to new water demands and future land use changes. The major source of water to the region, the Colorado River, is vulnerable because of the prolonged Colorado River Basin drought and recent litigation which could impact the stability of the 2003 Quantitative Settlement Agreement (QSA). In addition, the region is characterized by cities and unincorporated communities that are spread over large areas resulting in high cost of projects and making outreach to remote and isolated communities difficult. However, the projects that have been developed through the planning efforts are expected to produce regional benefits that include water quality improvement, enhancement of water supply reliability, ecosystem improvement, flood control enhancement, enhanced partnerships and public participation, understanding of water-related issues, and improved water management.

Vulnerabilities to the SWP water supplies also exist. The Coachella Valley Water District and Desert Water Agency are being subjected to reductions in their annual allocations because of the federal court ruling on Delta diversions.

Although characterized by very low annual precipitation, the region is subject to local thunderstorms that cover smaller areas and result in high-intensity precipitation of short duration. In the late 1970's, severe flood damage occurred to homes and businesses in many cities in the Coachella Valley region and, as a result, flood control infrastructure was constructed in the early 1980's with the help of the U.S. Army Corps of Engineers (USACE) and local funding. However, many areas still lack flood control facilities and are vulnerable to devastating alluvial fan flash riverine flooding. In some areas, the lack of a regional agency with jurisdiction over multiple service areas and a stable funding mechanism has been identified as the largest constraint to solving stormwater and flood problems. The lack of adequate stormwater management and conveyance infrastructure is, however, pervasive throughout the hydrologic region and remains the biggest constraint to economic development of planned urban areas.

The IRWM process has provided a rare opportunity for increased water management coordination and collaboration among agencies in the region, even as the region is faced with significant water resources challenges. Increasing use of recycled water is helping to offset the use of groundwater for non-potable uses, resulting in energy savings and reduced costs of pumping from deep wells. Recycled water

distribution systems are being expanded to maximize the use of recycled water in the region. Inter-agency partnerships on regional projects would help alleviate challenges associated with bringing recycled water supply to customers and upgrading of existing treatment facilities to provide tertiary treatment and improved opportunities to reuse the water.

The freshwater marshes and wetlands of Salton Sea face rising salinity through evaporation and declining water elevations. At the same time, prolonged Colorado River Basin drought and climate change scenarios point to decreased runoff to the Colorado River. Preservation and restoration of these water sources and the quality of their water is critical to the survival and propagation of numerous wildlife species.

Excessive pumping has put many of the groundwater basins in the region in a state of overdraft causing groundwater levels to decrease considerably in many areas and raising significant concern about water quality degradation and land subsidence. There is a need to diversify water portfolio components to reduce pressure on the use of groundwater in addition to promoting water use efficiency and conservation.

Elevated levels of arsenic in the groundwater, degradation from salts in using Colorado River water for recharge and irrigation, and saline intrusion from Salton Sea have all led to water quality issues. Similarly, failing septic systems and a high density of septic tanks and leach fields in some areas have the potential to contaminate the local groundwater basins. Reducing groundwater overdraft and developing and implementing a Salts and Nutrients Management Plan and conversion of septic tanks to sewer system will help alleviate these problems.

As mentioned earlier, the region has many DACs scattered over a large area with many falling into the category of Severely Disadvantaged Communities (SDACs). Tribal lands have their own unique challenges. Lack of adequate water and wastewater infrastructure is prevalent in these communities. Many of them have expressed concerns that their needs are being neglected in favor of the urban areas. Engaging DACs and sustaining their involvement is a necessary first step in providing access and affordability to safe drinking water and wastewater systems for these communities.

Typically, flood management agencies in large urban areas tend to be highly organized. Agencies in more rural counties or with low exposure to flooding are often handled by emergency responders or a single contact at the county. This can present a unique set of challenges when developing a project.

Flood management in the Colorado River Hydrologic Region of California has a unique set of challenges that were identified during meetings with local agencies. These challenges include:

- Flood control in the desert presenting different challenges than flooding in the rest of the state
- Inadequate agency alignment
- Right-of-way restrictions that impact projects and future management options
- Outdated and undersized infrastructure
- Inconsistent and unreliable funding
- Lack of regional perspective, real need for regional planning efforts
- Agencies need more clearly designed and articulated roles and responsibilities
- Inadequate public and policymaker awareness and education
- Permitting that is overly complex, involves too many agencies, takes too long, and is costly
- Land use conflicts

Climate change will have a significant impact on the timing and magnitude of precipitation and runoff. Increased air temperatures could reduce the extent of snow pack in mountainous areas, thereby adding to the portion of watersheds that are available to contribute to direct winter runoff. Decreased snow pack would also reduce spring runoff volumes. Although future precipitation is somewhat uncertain, greater flood magnitudes are anticipated due to more frequent atmospheric river storm events (Dettinger, 2011). These changes could alter the magnitude and frequency of flood events, although specific effects might be difficult to reliably predict. However, the potential for increased frequency and magnitude of floods suggest that the enhancement of both structural and nonstructural measures for flood management is needed.

[Placeholder: Groundwater content being developed including:

- Summary of the number of GWMPs that are not SB1938 compliant, or only partially SB 1938 compliant. The challenges associated implementing the SB 1938 groundwater management criteria, and recommendations for improving or incorporating sustainable practices into local groundwater management.
- Map showing high priority basins for the Hydrologic Region those do not have SB 1938 compliant GWMPs. The map shows overall area without compliant groundwater management planning, not area of individual groundwater basins.
- Summary of lessons learned from various Case Studies.]

## Drought and Flood Planning

Imperial County has created a flood management plan in cooperation with Imperial Irrigation District, Imperial County School District, and Salton Community Services District. This plan identifies vulnerable areas (e.g., Calipatria), discusses various techniques for lessening flood risk, and contains a general implementation plan.

The Disaster Mitigation Act of 2000 provided financial incentives to states and local entities for developing Hazard Mitigation Plans (HMPs) that identify actions for mitigating disasters and contain strategies for action implementation. Currently, Riverside, San Diego, and San Bernardino counties have FEMA-approved HMPs that discuss flooding issues and the measures most likely to alleviate those risks. All three plans are multi-jurisdictional and consider flood risks and mitigation at various governmental levels. Imperial County has prepared a draft plan that is available for public review.

In late 2006, the IID Board of Directors approved the development of an equitable distribution plan to apportion agricultural water users using the straight-line method for years that conditions trigger a supply/demand imbalance (SDI) declaration. In December 2007, the IID Board passed a resolution approving the new regulations and authorizing the general manager to implement them. Also in December 2007, the Secretary of the Interior signed *Colorado River Interim Guidelines for Lower Basin Shortages and Coordinated Operations for Lakes Powell and Mead*. The four key elements of the new guidelines:

- Establish rules for shortages specifying who will take reductions and when they take them, which is essential for prudent water planning in times of drought.
- Establish new operational rules for Lake Powell and Lake Mead to allow these reservoirs to rise and fall in tandem, thereby better sharing the risk of drought.

- Establish rules for surpluses so if the basin has ample runoff the Department of the Interior will have rules in place to distribute the extra water.
- Address the ongoing drought by encouraging new initiatives for water conservation.

### **Levee and Channel System**

Lakes Mead and Powell on the Colorado River provide flood protection for the Colorado River Hydrologic Region from north of Needles to the international border with Mexico near Winterhaven. Other flood protection measures include Wide Canyon Reservoir in West Wide Canyon, a detention basin on Tahchevah Creek, a debris basin, levees, channel improvements, groins, and bank protection.

## **Resource Management Strategies**

[Note: (1) Align with resource management strategy impacts and benefits of IRWM standards. (2) Information for this section will be regionally derived. The “statewide” strategies (i.e., the updated text from Volume 2 of Update 2009) will be published in a separate volume, not in these regional reports.]

### **Strategy Availability**

[This subsection contains a discussion of the following topics.

- Subset of 27 strategies that are potentially applicable within each region.
- Estimate of benefits that could be achieved considering all constraints (e.g., institutional regulatory, finance, local opposition, technology, conveyance, local land use, etc.).]

[Considerations for this subsection:

- Estimation of resource management strategy potential of the 27 strategies detailed in Volume 2 of Update 2009.
- Water Evaluation and Planning (WEAP) results for the Sacramento, San Joaquin, and Tulare Lake Hydrologic Regions.]

### **Regional Strategies**

[Placeholder: Groundwater content being developed including:

- Discussion of the various existing groundwater related management strategies as it relates to groundwater management plans and IRWM plans, as well as conjunctive management projects and groundwater recharge projects, etc.
- Table listing the existing groundwater related management strategies.]

[This subsection contains a discussion of the following topics.

- Regional response packages for managing future water supply, managing flood risk, managing water quality, adapting to climate change, and achieving sustainability.]

[Considerations for this subsection:

- Highlight response strategies important to the region.
- This section will inform the strategy and policy recommendations in Volume 1 of the Update 2013 as themes become evident.
- Number of accepted plans.]

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[Placeholder: Groundwater references for all cited materials in text.]

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California Adaptation Planning Guide

([http://resources.ca.gov/climate\\_adaptation/local\\_government/adaptation\\_planning\\_guide.html](http://resources.ca.gov/climate_adaptation/local_government/adaptation_planning_guide.html)), developed into four complementary documents by the California Emergency Management Agency and the California Natural Resources Agency to assist local agencies in climate change adaptation planning

Cal-Adapt (<http://cal-adapt.org/>), an on-line tool designed to provide access to data and information produced by California's scientific and research community

Urban Forest Management Plan Toolkit ([www.UFMPtoolkit.com](http://www.UFMPtoolkit.com)), sponsored by the California Department of Forestry and Fire Management to help local communities manage urban forests to deliver multiple benefits, such as cleaner water, energy conservation, and reduced heat-island effects

California Climate Change Portal (<http://www.climatechange.ca.gov/>)

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[Placeholder: Groundwater content being developed to provide additional information regarding methods and assumptions related to the groundwater-related data and analyses.]

## **Personal Communications**

[List references here.]

**Table CR-1 Colorado River Hydrologic Region Annual Averages of Temperatures and Precipitation**

<b>Year</b>	<b>Average Temperatures Maximum (F°)</b>	<b>Average Temperatures Minimum (F°)</b>	<b>Average Daily Temperatures (F°)</b>	<b>Average Annual Precipitation (in)</b>	<b>Average ETo (in) <sup>a</sup></b>
2005	86.41	56.19	71.07	3.62	68.81
2006	87.11	55.79	71.21	0.95	71.66
2007	86.90	55.21	70.98	1.26	70.57
2008	87.19	55.86	71.56	1.77	70.71
2009	87.25	55.15	71.46	1.23	71.84
2010	86.02	55.61	70.97	3.42	71.13

Source: California Irrigation Management Information System.

<sup>a</sup> ETo – Reference evapotranspiration.

**Table CR-2 Top Six Crops of Colorado River Hydrologic Region, 2009 (Acres)**

<b>Crop</b>	<b>Harvested Acres</b>
Alfalfa	171,000
Wheat and other grains	116,300
Pasture including Bermuda	88,200
Lettuce and salad greens <sup>a</sup>	46,000
Sudan grass	41,400
Citrus and subtropical fruit including dates	32,500

<sup>a</sup> Total harvested acres of all truck and vegetables crops was 140,100.

Harvested acres for cole crops (broccoli, cauliflower, cabbage) was 23,500.

**Table CR-4 Key Elements of the Law of the Colorado River**

<b>Document</b>	<b>Date</b>	<b>Main purpose</b>
Colorado River Compact	1922	The Upper and Lower Basin are each provided a basic apportionment of 7.5 MAF annually of consumptive use. The Lower Basin is given the right to increase its consumptive use by an additional 1.0 MAF annually.
Boulder Canyon Project Act	1928	Authorized USBR to construct Hoover Dam and the All-American Canal (including the Coachella Canal), and gave congressional consent to the Colorado River Compact. Apportioned the Lower Basin's 7.5 MAF among the states of Arizona (2.8 MAF), California (4.4 MAF), and Nevada (0.3 MAF). Provided that all users of Colorado River water stored in Lake Mead must enter into a contract with USBR for use of the water.
California Limitation Act	1929	Confirmed California's share of the 7.5 MAF Lower Basin allocation to 4.4 MAF annually, plus no more than half of any surplus waters.
California Seven-Party Agreement	California Seven-Party Agreement	An agreement among seven California water agencies/districts to recommend to the Secretary of Interior how to divide use of California's apportionment among the California water users.
US-Mexican Water Treaty	1944	Apports Mexico a supply of 1.5 MAF annually of Colorado River water, except under surplus or extraordinary drought conditions.
US Supreme Court Decree in Arizona v. California, et al.	1964, supplemented 1979	Rejected California's argument that Arizona's use of water from the Gila River, a Colorado River tributary, constituted use of its Colorado River apportionment. Ruled that Lower Basin states have a right to appropriate and use tributary flows before the tributary co-mingles with the Colorado River. Mandated the preparation of annual reports documenting the uses of water in the three Lower Basin states. Quantifies tribal water rights for specified tribes, including 131,400 afy for diversion in California. Quantified Colorado River mainstream present perfected rights in the Lower Basin states.
Colorado River Basin Project Act	1968	Authorized construction of the Central Arizona Project. Requires Secretary of the Interior to prepare long-range operating criteria for major Colorado River reservoirs.
Criteria for Coordinated Long-Range Operation of Colorado River Reservoirs	1970, amended 2005	Provided for the coordinated operation of reservoirs in the Upper and Lower Basins and set conditions for water releases from Lake Powell and Lake Mead.
Colorado River Water Delivery Agreement: Federal Quantification Settlement Agreement of 2003	2003	Complex package of agreements that, in addition to many other important issues, further quantifies priorities established in the 1931 California Seven-Party Agreement and enables specified water transfers (such as the water conserved through lining of the All-American and Coachella canals to SDCWA) in California.

Source: Adapted from USBR 2008c

**Table CR-5 Annual Intrastate Apportionment of Water from the Colorado River Mainstream within California under the Seven Party Agreement<sup>a</sup>**

Priority Number	Apportionment
Priority 1	Palo Verde Irrigation District (based on area of 104,500 acres).
Priority 2	Lands in California within USBR's Yuma Project (not to exceed 25,000 acres).
Priority 3	Imperial Irrigation District and lands served from the All American Canal in Imperial and Coachella Valleys, and Palo Verde Irrigation District for use on 16,000 acres in the Lower Palo Verde Mesa.
Priorities 1 through 3 collectively are not to exceed 3.85 maf/yr. The Seven Party Agreement did not quantify the division of this volume among the three parties. Priorities 1-3 were further defined in the 2003 Quantification Settlement Agreement.	
Priority 4	MWDSC for coastal plain of Southern California-550,000 af/yr.
Priority 5	An additional 550,000 af/yr to MWDSC, and 112,000 af/yr for the City and County of San Diego. <sup>b</sup>
Priority 6	Imperial Irrigation District and lands served from the All American Canal in Imperial and Coachella Valleys, and Palo Verde Irrigation District for use on 16,000 acres in the Lower Palo Verde Mesa, for a total not to exceed 300 taf/yr.
Total of Priorities 1 through 6 is 5.362 maf/yr.	
Priority 7	All remaining water available for use in California, for agricultural use in California's Colorado River Basin.

<sup>a</sup> Indian Tribes and miscellaneous present perfected right holders that are not encompassed in California's Seven Party Agreement have the right to divert up to approximately 90 taf /yr (equating to about 50 taf/yr of consumptive use) within California's 4.4 maf basic apportionment. Present consumptive use under these miscellaneous and Indian present perfected rights is approximately 15 taf/yr.

<sup>b</sup> Subsequent to execution of the Seven Party Agreement, MWDSC, SDCWA, and the city of San Diego executed a separate agreement transferring its apportionment to MWDSC.

<sup>c</sup> Under the Colorado River Water Delivery Agreement: Federal Quantification Settlement Agreement of 2003, MWD (and SDCWA) gained access to water that may be available under Priority 6 and 7.

NOTE: (amounts represent consumptive use)

**Table CR-6 Annual Apportionment of Use of Colorado River Water Interstate/International**

Description	Amount
Upper Basin. Required to deliver 75 maf over a 10-year period measured at Lee Ferry. (small portion of Arizona, Colorado, New Mexico, Utah, and Wyoming)	7.5 maf
Lower Basin. (portions of Arizona, Nevada, California, and Utah draining below Lee Ferry)	7.5 maf plus 1 maf
Republic of Mexico <sup>a</sup>	1.5 maf
Total	17.5 maf <sup>b</sup>

<sup>a</sup> Plus 200 taf of surplus water, when available as determined by the United States. Water delivered to Mexico must meet specified salinity requirements. During an extraordinary drought or other cause resulting in reduced uses in the United States, deliveries to Mexico would be reduced proportionally with uses in the United States.

<sup>b</sup> The total volume is  $(7.5 + 7.5 + 1.0 + 1.5) = 17.5$  maf/yr. Note that this total refers to all waters of the Colorado River System, which is defined as that portion of the Colorado River and its tributaries in the United States.

NOTE: Amounts represent consumptive use; taf = thousand acre-feet; maf = million acre-feet

**Table CR-7 Colorado River Water Delivery Agreement: Federal Quantification Settlement Agreement of 2003 for Priorities 1-3 — Quantification and Annual Approved Net Consumptive Use of Colorado River Water by California Agricultural Agencies**

	Priority 1, 2, 3a and 3b quantified amount	Quantified net consumptive use, 2010	Actual net consumptive use, 2010	Quantified annual net consumptive use, 2026– 2047
Priority 1, 2, and 3b. Based on historical average use; deliveries above this amount in a given year will be deducted from MWD's diversion (order) for the next year; as agreed by MWD, IID, CVWD, and Secretary of the Interior (PVID and the Yuma Project are not signatories to the federal QSA.)	420.0 taf	420.0 taf	312.2 taf d/	420.0 taf
Priority 3a CVWD	330.0 taf	333.0 taf	306.1 taf	424.0 taf
Priority 3a Imperial Irrigation District	3,100.0 taf	2733.8 taf	2545.6 taf b/	2,607.8 taf
Total California Agricultural Use	3,850.0 taf	3,486.8 taf	3,163.9 taf	3,446.3 taf
IID CRWDA Exhibit C Payback		19.0 taf	0 taf b/	0 taf
CVWD CRWDA Exhibit C Payback		9.2 taf	0 taf b/	0 taf
Total Priority 1-3 Use	3,850.0 taf	3515.0 taf	3163.9 taf	3,446.3 taf
Remainder of 3.85 maftaf for use by MWD (and SDCWA and 14.5 taf Misc. PPRs) through priority rights and transfer agreements.	0 taf	335.0 taf c/	686.1 taf c/	403.7 taf c/

<sup>a</sup> Consumptive use is defined in the federal QSA as "the diversion of water from the main stream of the Colorado River, including water drawn from the main stream by underground pumping, net of measured and unmeasured return flows."

<sup>b</sup> Exhibit C obligations were fully extinguished in 2009.b. IID and USBR disagree on the calculation of this value. It will be finalized upon resolution of the issue.

<sup>c</sup> Includes miscellaneous present perfected rights, federal rights reserved, and decreed rights.

<sup>d</sup> Includes Palo Verde Irrigation District, Yuma Project Reservation Division, and Yuma Island Pumpers

Data sources:

Colorado River Water Delivery Agreement: Federal Quantification Settlement Agreement for the purposes of Section 5(b) of Interim surplus Guidelines, Exhibits A, B and C, approved by the Secretary of the Interior on October 10 2003, <http://www.usbr.gov/lc/region/g4000/QSA/crwda.pdf>

Colorado River Accounting and Water User Report:: Arizona, California, and Nevada, Calendar Year 2010, US Department of the Interior, Bureau of Reclamation Lower Colorado Region, pp 37, <http://www.usbr.gov/lc/region/g4000/4200Rpts/DecreeRpt/2010/2010.pdf>

(amounts represent net consumptive use) a/

Note: taf = thousand acre-feet

**Table CR-9 Summary of Large, Medium, Small, and Very Small Community Drinking Water Systems in the Colorado River Hydrologic Region**

Water System Size	Community Water Systems		Population Served	
	(Systems)	(%)	(Population)	(%)
Large (> 10,000 Pop)	15	12%	716,977	87%
Medium (3,301–10,000 Pop)	12	9%	67,673	8%
Small (500–3,300 Pop)	23	18%	28,719	3%
Very Small (<500 Pop)	79	61%	13,140	2%
CWS that Primarily Provide Wholesale Water	0	0%	---	---
Total	129		826,509	

**Table CR-10 Summary of Small, Medium, and Large Community Drinking Water Systems in the Colorado River Hydrologic Region that Rely on One or More Contaminated Groundwater Well(s)**

Community Drinking Water Systems and Groundwater Wells Grouped by Water System Population	No. of Affected Community Drinking Water Systems	No. of Affected Community Drinking Water Wells
Small Systems ≤ 3,300	17	31
Medium Systems 3,301 – 10,000	2	7
Large Systems > 10,000	5	13
Total	24	51

Source: Water Boards 2012 Draft Report on “Communities that Rely on Contaminated Groundwater”

Note: Affected Wells exceeded a Primary Maximum Contaminant Level prior to treatment at least twice from 2002 to 2010. Gross alpha levels were used as a screening assessment only and did not consider uranium correction.

**Table CR-11 Summary of Contaminants Affecting Community Drinking Water Systems in the Colorado River Hydrologic Region**

<b>Principal contaminant (PC)</b>	<b>Community drinking water systems where PC exceeds the primary MCL</b>	<b>Community drinking water wells where PC exceeds the primary MCL</b>
Gross alpha particle activity	13	23
Uranium	10	17
Arsenic	9	19
Fluoride	7	13

Source: Water Boards 2012 Draft Report on "Communities that Rely on Contaminated Groundwater"

Notes:

Only top 4 contaminants shown.

Affected Wells exceeded a Primary Maximum Contaminant Level prior to treatment at least twice from 2002 to 2010. Gross alpha levels were used as a screening assessment only and did not consider uranium correction.

**Table CR-12 Flood Exposure in the Colorado River Hydrologic Region**  
**Exposures to the 100-Year and 500-Year Flood Events**














<b>Segment Exposed</b>	<b>1% (100-yr) Floodplain</b>	<b>0.2% (500-yr) Floodplain</b>
Population	31,400, 5%	227,100, 38%
Structure and Content Value	\$2.5 billion	\$20.6 billion
Crop Value	\$146.1 million	\$275.7 million
Crop (acres)	49,000	79,100
Tribal Lands (acres)	29,154	57,499
Essential Facilities (count)	20	113
High Potential-Loss Facilities (count)	10	15
Lifeline Utilities (count)	9	22
Transportation Facilities (count)	180	319
Department of Defense Facilities (count)	4	4
State and Federal Threatened, Endangered, Listed ,and Rare Plants <sup>a</sup>	78	85
State and Federal Threatened, Endangered, Listed ,and Rare Animals <sup>a</sup>	99	101

Source: SFMP California's Flood Future Report.

Note:

<sup>a</sup> Many Sensitive Species have multiple occurrences throughout the state and some have very large geographic footprints that may overlap more than one analysis region. As a result, a single Sensitive Species could be counted in more than one analysis region. Because of this the reported statewide totals will be less than the sum of the individual analyses regions.

**Figure CR-2 Energy Intensity**

type of water	energy intensity (  white bulb = 0;  yellow bulb = 1-500 Kwh./AF)
Colorado (Project)	
Federal (Project)	<i>None in this region</i>
State (Project)	       
Local (Project)	
Local Imports	
Groundwater	